SCIENTIFIC AMERICAN

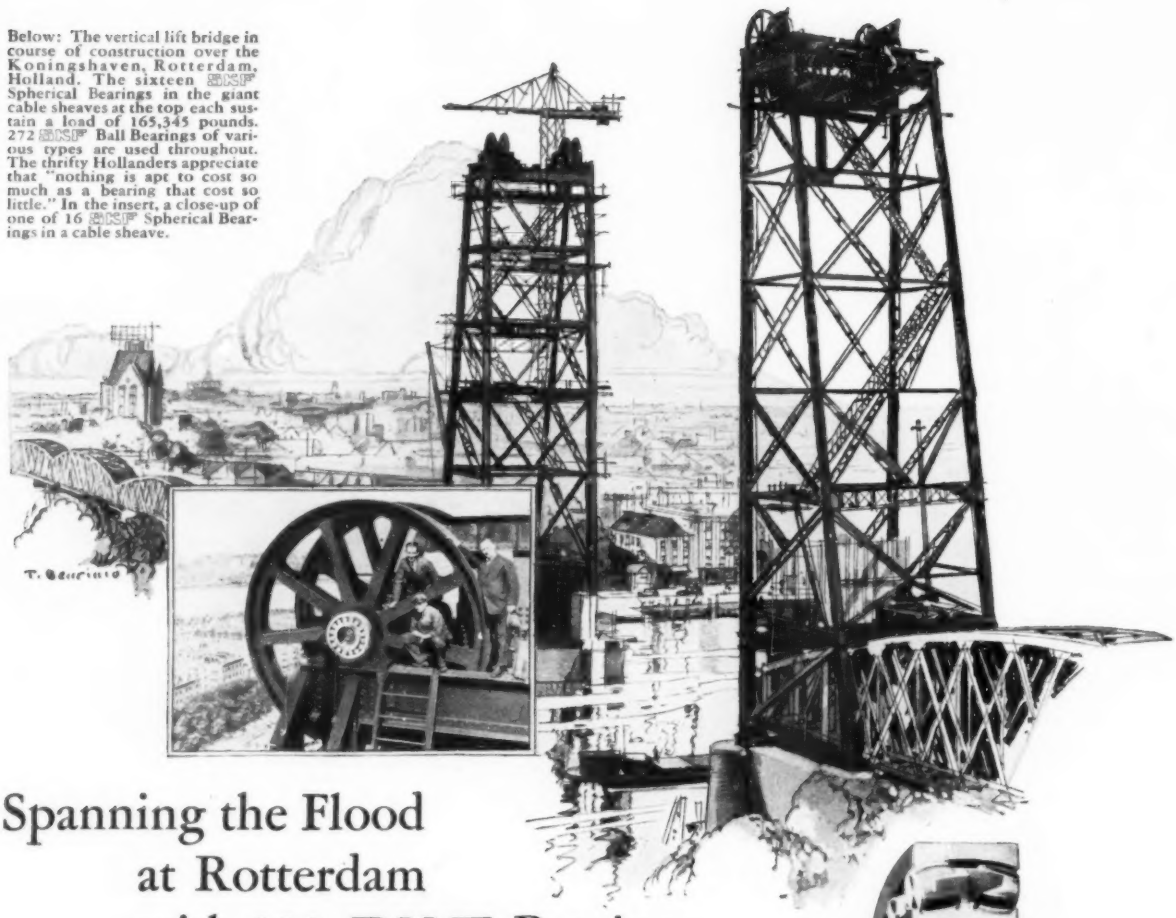
September 1928 ★ 35¢ a Copy

PRIMITIVE AUSTRALIAN BLACKS

NAVAL ADEQUACY—Part I

FARM AID FACTS

Below: The vertical lift bridge in course of construction over the Koningshaven, Rotterdam, Holland. The sixteen SKF Spherical Bearings in the giant cable sheaves at the top each sustain a load of 165,345 pounds. 272 SKF Ball Bearings of various types are used throughout. The thrifty Hollanders appreciate that "nothing is apt to cost so much as a bearing that cost so little." In the insert, a close-up of one of 16 SKF Spherical Bearings in a cable sheave.



Spanning the Flood at Rotterdam with 288 SKF Bearings

IT'S a far, far cry from the new vertical lift bridge over the Koningshaven at Rotterdam, but there's a story behind it that echoes wherever anti-friction bearings are used—even on *this* side of the Atlantic.

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GASOLINE + ETHYL = *high compression performance*

YOU are hearing much about "high compression"..."high compression engines"..."high compression fuel"..."high compression performance."

"What," a great many car owners are asking, "does 'high compression' mean to me?" Here is a simple explanation:

Each cylinder of your engine may be likened to a muzzle-loading gun. The cylinder is the gun; the piston is the bullet; and the mixture of gasoline and air is the powder charge.

The tighter you pack the powder charge in the gun before firing, the greater the force to the bullet. Similarly, the tighter you squeeze —or compress—gas vapor and air in the combustion chamber before ignition, the greater the force of the piston's stroke. In other words, the higher the compression the greater the power.

Higher compression in a gasoline engine is obtained by decreasing the size of the combustion chamber—either by mechanical design or by carbon formation.

Up to the advent of Ethyl Gasoline, the compression of automobile engines was limited by the compression limits of gasoline. For gasoline is not a perfect fuel. It explodes too soon ("knocks") and loses power when squeezed beyond a certain point.

That is why General Motors Research Laboratories developed ETHYL fluid, a compound which controls the combustion rate of gasoline so that as engine compression is raised the "knock" is eliminated. And that is why oil companies are mixing ETHYL fluid with gasoline to form *Ethyl Gasoline*—the standard high compression fuel.

Within the last year, car manufacturers have been able to produce new models of higher compression and greater power. *But the most immediate benefits of Ethyl Gasoline are found among the millions of owners of cars of ordinary compression, because with its use in such cars carbon becomes an asset.*

Ride with ETHYL. See what a great difference it makes on hills and in traffic. No "knocking." Less shifting. Faster pickup. Stop at an ETHYL pump today—it bears the emblem shown at the left.

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BRAND OF ANTI-KNOCK COMPOUND
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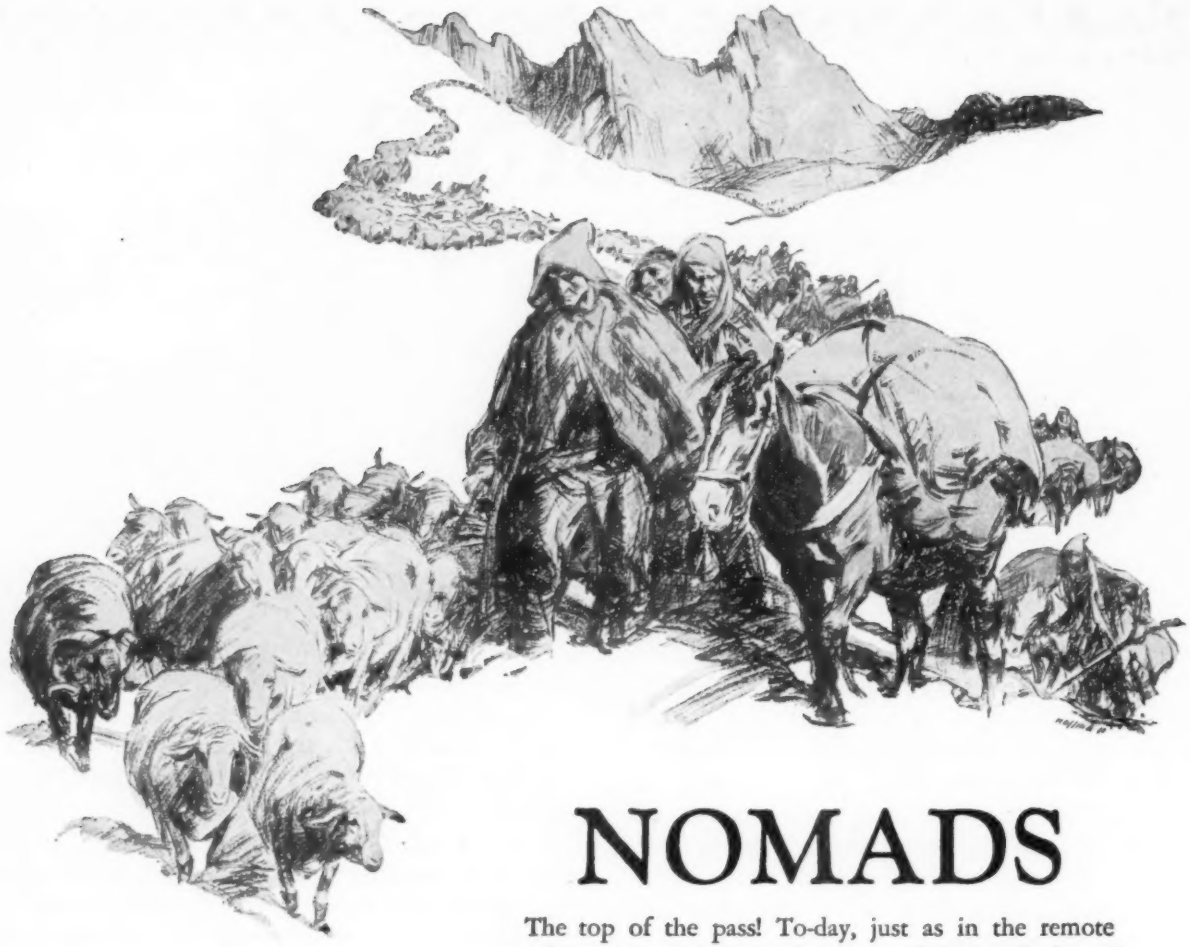

NOMADS

The top of the pass! To-day, just as in the remote Biblical age when herdsmen tended the flocks of Abraham, these nomad tribes drive their flocks each season up from the parched desert to the high table-lands of the Caucasus, green with life-giving grass.

We moderns of the West make no such forced marches in search of food. In our lands of little rain, electricity pumps water to make the desert bloom. Electricity lights the herdsman's home and milks the cows in his stable. Electricity powers the great network of transportation and communication which binds city and country into one complex system of civilized living.

Yet, as Thomas A. Edison has written, "The electrical development of America has only well begun. So long as there remains a single task being done by men and women which electricity could do as well, so long will that development be incomplete."

This monogram appears on a multitude of products which contribute to the efficiency and comfort of both factory and home. It is your assurance of electrical correctness and dependability.

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GENERAL ELECTRIC

SCIENTIFIC AMERICAN

24 WEST 40th STREET — NEW YORK CITY

September 1928 — *Edited by ORSON D. MUNN* — *Eighty-fourth Year*

IN THIS ISSUE

CONTENTS—SEPTEMBER, 1928

COVER

For our cover illustration this month, our artist, Howard V. Brown, has strikingly depicted an Australian native in ceremonial dress. The mask and headdress, as well as the design on the chest and arms, is made of tufts of cotton stuck in place with human blood. These interesting natives are dealt with in more detail in the article starting on page 201. For the data for preparing the cover we are indebted to the book, "Native Tribes of the Northern Territory of Australia," by Sir Baldwin Spencer, published by The Macmillan Company.

Scientific American, September, 1923, Vol. 139, No. 3, entered at the New York, N. Y., Post Office as Second Class Matter June 28th, 1879, under the Act of March 3rd, 1879; additional entry at Dunellen, N. J. Published Monthly by Scientific American Publishing Co., 24 West 40th Street, New York City. Copyright 1923 by Scientific American Publishing Co. Great Britain Rights Reserved. Subscription Price $4.00 per year

Looking Ahead *With the* Editor

In a Dog's World

JUST how intelligent is the family pet dog that does a few "tricks"? What constitutes intelligence in a dog, anyway? Does he understand words, or does he simply interpret inflections? Can he ever be taught to talk? These and similar questions will be discussed at length in an article that is scheduled for early publication. Look for this feature which will give you a new understanding of the psychology and life of the dog.

Excavating in Transjordania

MORE about Montfort, the crusader's castle in the Holy Land which was described in the February issue, is coming in an article written by the director of the expedition. In this article—which is almost a "travelog" because of the wealth of interesting travel notes it contains—details of the excavations are given, and much is told of Transjordania and of Jerash which is to be excavated at an early date by Yale University in co-operation with the British School of Archeology.

Wooden Highways that Carry Rivers

IMAGINE a pipe-line made of wood and large enough to carry an entire river! The Romans made their pipe lines of wood by burning out logs, but modern man makes his on a larger scale by fastening staves together to form a pipe 12, 14, or 16 feet in diameter. Read in an early issue the details of this stupendous engineering undertaking—how the pipes are made and then installed, winding across country like enormous snakes.

Underground Animals

CRAWLING through extremely narrow, slimy passages, Dr. Noble of the American Museum of Natural History found what he was looking for in the vast caves of the Ozarks: blind salamanders. He found blind crayfish, myriads of bats in a noisome cavern, and caught 100 salamanders which he brought to New York for further study. His story of the exploration, tinged with the spice of high adventure, will be published soon.

The Kubus

PRIMITIVE almost beyond belief, filthy, diseased, and lazy, a tribe of Kubus, found in the Dutch East Indies and studied by an ethnographer, was so unwholesome as to be obnoxious even to the Malay guide. The article describing these people and telling something of their habits, now ready for publication, is more than a scientific document—it is a picture of a people pathetically child-like and backward. Be sure to look for it.

Every Issue Fully Illustrated

¶ Great minds, they say, run in the same channels. Many minds universally conceded to be among the greatest read SCIENTIFIC AMERICAN *regularly. Do you? A subscription is only four dollars a year.*

Among our Contributors

Elihu Thomson

In the world of science and industry, there is no scientist or technical man who is so highly regarded as Dr. Elihu Thomson. At the age of 75, after having made over 700 inventions during an active life, he retains active directorship of the research laboratory at Lynn, Massachusetts. As long ago as 1875, he anticipated Hertz by transmitting spark signals over a distance of 100 feet, a fact not generally known.

Capt. Nelson H. Goss, U.S.N.

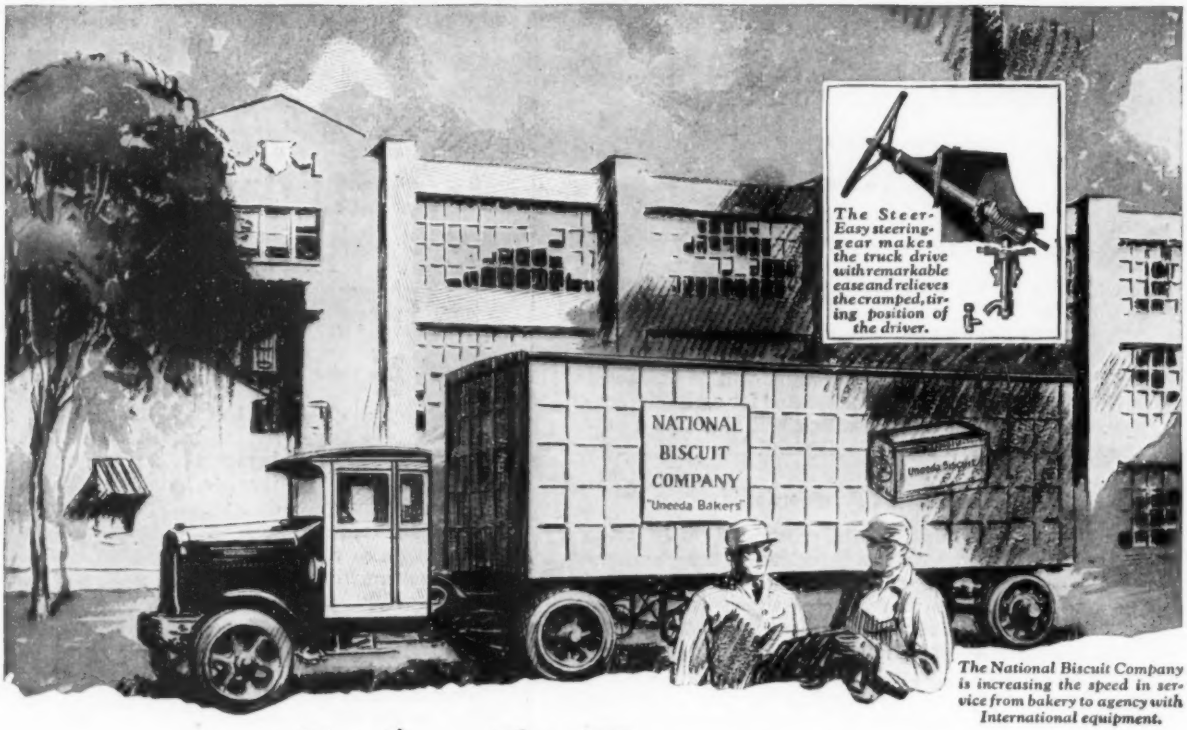
With zeal and energy characteristic of one who was on the varsity eleven and the varsity crew at the Naval Academy, from which he was graduated in 1905, Captain Goss has applied himself to the study of naval questions, and is well fitted to speak authoritatively on the subject. During the World War he commanded destroyers and destroyer escorts. He is a graduate of the War College and a strategist of high standing. Follow his articles closely.

Clark Wissler

Besides being a scientist of outstanding accomplishments in anthropology and psychology, Dr. Wissler is perhaps a better museum man than some others in like positions. As Curator of Anthropology at the American Museum of Natural History in New York City, his enviable ability to combine his wide knowledge of scientific subjects and his fine grasp of museum methods is nothing short of genius.

James Stokley

Formerly a teacher, Mr. Stokley is now a staff writer and Assistant Treasurer of Science Service, a position to which he was appointed in 1925. He is a member of several scientific societies in the United States, England, and France. In his article about the cruise of the *Carnegie*, beginning on page 240, he corrects some popular fallacies concerning the construction of this non-magnetic ship and the purpose of its long cruise.



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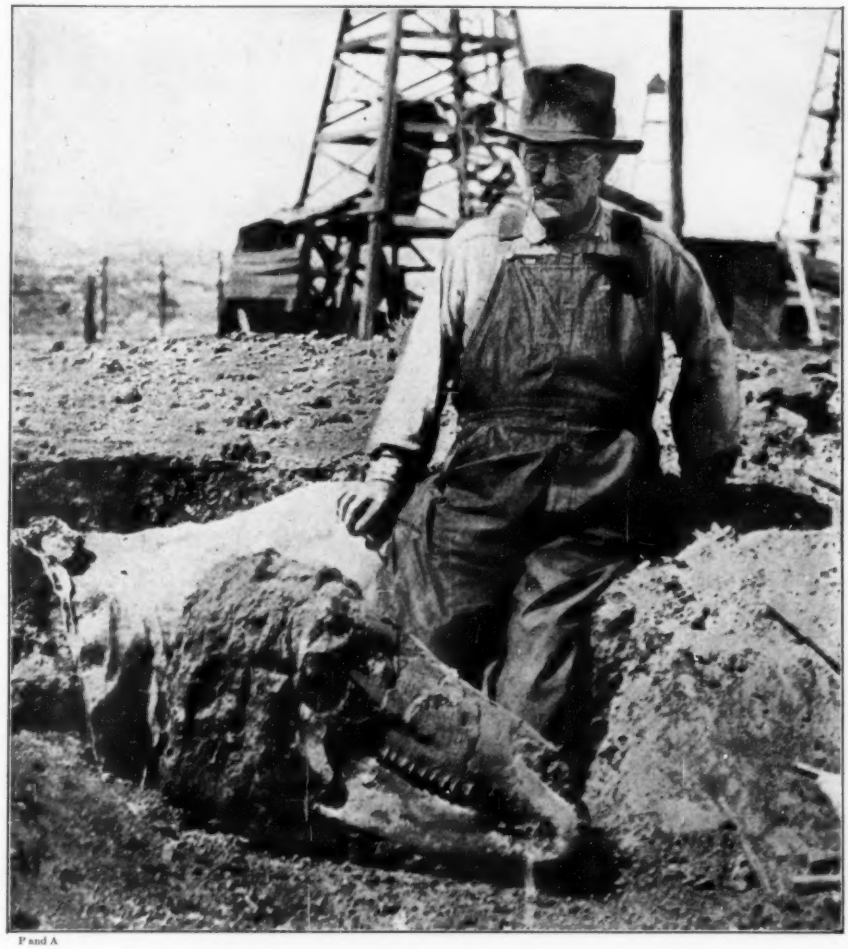
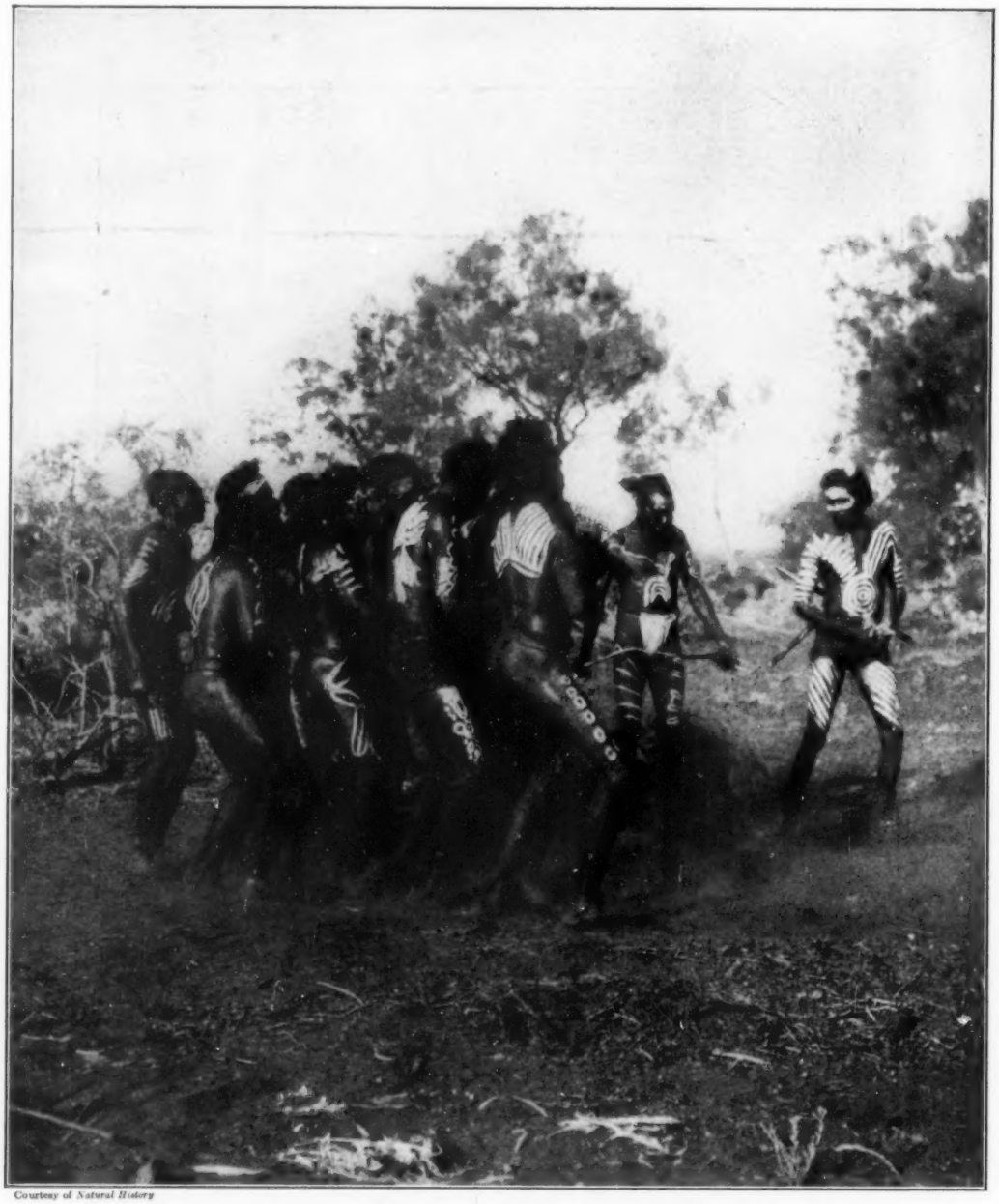


P and A

Charles Hazelius Sternberg

THERE is a striking romance in the career of a professional fossil hunter. His territory is the whole of the earth, his scope the whole of past geologic time and he must be a keen student of the record of the rocks. Mr. Sternberg, whose vivid account of a remarkable discovery appears on page 225, has been a fossil hunter since 1876 and is the oldest living member of his profession. He has worked under such famed scientists as Cope, Agassiz, and Marsh, great pioneers of paleontology, and his many collections may be seen in the United States National Museum, the American Museum of Natural History, the British Museum, and at Cornell, Princeton, and Yale. He is the author of "The Life of a Fossil Hunter" and "Hunting Dinosaurs," and his home is in San Diego, California. Here we see him in typical field accoutrement at McKittrick, California, engaged in the infinitely painstaking task of revealing the skull of a fossil horse without injury to it. In some cases the fragments of fossils are so frail that only the expert, with years of experience and marked skill as well as patience, can work them out of the rock in restorable condition and transport them to a distant spot. At this work Mr. Sternberg is a past master.



Courtesy of *Natural History*

Ceremonial Dance at the Sacred Tree

A QUESTION which may well be asked is "what was the meaning of this curious procedure?" This is a very complicated anthropological question which is summed up briefly as follows: Most Australian tribes are divided into family groups, each group having a family totem. The words "totem" and "totemism" refer to widespread primitive religion with social as well as religious observances combined. Among the Australian tribesmen the totem is usually an animal or a plant, and although not looked upon as a god, yet it holds a serious relation to every member of the group. With the belief goes a ritual which must be observed at a certain time of the year. What Dr. Wissler describes in the article beginning on the opposite page was the totem ritual of the group whose camp he visited. Not many white men have been permitted to see the sacred ceremonies of the Blacks of the western part of Australia.

All photographs courtesy *Natural History*

MAKING FIRE WITH A WOODEN FIRE DRILL

This native method of making fire is very crude, for the drill is rotated between the palms instead of by a bow as is done by savages more advanced in knowledge. Natives are in ceremonial dress

Among the "Blacks" of Western Australia

A White Man Visits One of Their Villages and Witnesses Their Odd Tribal Dances and Customs

By DR. CLARK WISSLER

Curator-in-Chief, Division of Anthropology, American Museum of Natural History

IN Australia the natives are called "Blacks," and most people seem to have the idea that the ways of the Australian native are decidedly "dark." At least everywhere we find him cited as the lowest of the low. Ask anyone where the lowest savages are to be found and the chances are that the answer will be "Australia." However, white people who live among these Blacks often come to have a high regard for them and rise to their defense when such statements are made.

IN 1925 the writer spent a few months in Australia, and, setting out from the city of Adelaide, made a quick trip westward to the edge of the open country, the present frontier of Australia. Today, as one travels west and north from Adelaide, the country grows rapidly dryer, and water becomes scarcer, soon bringing one to the great sandy plains, where roam tribes of Blacks who are still to see their first white man.

Our friends in Adelaide, knowing that we were anxious to see the Black in his native country, had arranged, in advance, for a visit to a sheep station, or ranch, near Tarcoola, about 500 miles westward, from which it was possible to reach the localities where camps of Blacks were to be expected. The manager of the station, Mr. McBride, welcomed us and did everything possible to make our visit pleasant and profitable.

AUSTRALIAN WOMAN

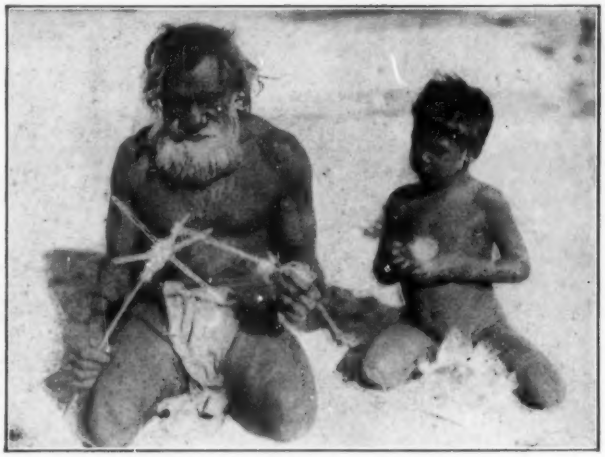
These scarifications shown on the body are common among the native men and women

Shortly after our arrival, in company with out host we set out in the two Fords to find a native camp which was said to be about 10 miles away. The sand was covered with scattered low clumps of blue bush, looking for all the world like sagebrush, with here and there a squat tree, called *mallee*—the "water tree" of the Blacks.

IN the course of an hour, dodging in and about between bushes and trees, and occasionally sticking in the loose sand, we came suddenly upon some natives running about and shouting. They were hastily putting on such old civilized clothing as they had in hand, because, not expecting white visitors, they were following their original habits. Nowadays, all natives are required to clothe themselves when in the presence of white people, so those who do approach the settlements keep at hand at least an excuse for a costume.

NATIVES DRESSED FOR VISITORS

The local missionary had supplied some of them with clothes. One woman became the camp aristocrat on account of her corduroy skirt



MAKING STRING FROM FUR

Before the rabbit was introduced into Australia the fur of native animals was used in the same way. Human hair is also used

We stepped out of our Fords into the midst of a camp of Blacks. The reception was friendly, and when a native employee of the ranch explained as best he could that we were Americans living far away, the leading men of the camp shook hands with us, making little speeches, the words of which were meaningless to us, but the kindly import of which was evident.

Whenever the Blacks make camp, they choose the side of a slight elevation or ridge; the reason is not far to seek. All serious ceremonies are for men only.

Women and children are not to see them or even to visit the place where they are held, so, as no one can see over the ridge from the camp, and the women and children are forbidden to go there, the sacred affairs of the tribe are safe from profanation. It is said that the usual punishment for spying upon the sacred ground is death. Such practices are common to all Australian natives and were known to us.

SCARCELY had we alighted in the camp, ere men began to approach over the top of this ridge. They were practically nude, but were decorated with paint and white down feathers. This, also, we knew to be the sign that a ceremony was in progress, and that was just the thing we longed to see. Not many white men have been permitted to see the sacred ceremonies of the Black.

Perhaps one reason why the Blacks are considered so low in the culture scale is their simple way of living. They build nothing in the way of houses, merely making a sort of low wind-break of brush in front of which a fire is built at night, for, as is the case in all dry countries, it is hot during the day, but the nights are frequently cold.

The Blacks' fireside furnishings are almost nothing: a digging-stick and a rude wooden dish; for the man, a spear, a boomerang, a short club, and a stone flake or two to serve as a knife. These are the essentials. If to this we now add a few scraps of clothing, a tin can or two, a pipe and tobacco, we have listed all that white contact has added.

THE Black never stays long in one place and without notice may pick up his few belongings and trot off through the brush to a new camp. Nor are his food habits to our taste; when large game fails, which is the rule, he resorts to snakes and insects; then his cooking is little more than a gesture toward the fire. Water is too scarce to wash in, and his hair is never combed. I think most readers will agree that such a life as this is about as near the negative pole as can be.

Yet, your opinion of the Black will rise with acquaintance. He is happy, a good hunter, and above all knows how to live in the desert. Without canteen or water jar, he sets out boldly where a white would not dare follow. It is not merely that he knows where the few water holes are to be found, but that he knows how to get water from the plants.

Every man in this camp had a long wooden spear; some of these had bone points, but usually the natural wood was merely shaped. These they can throw with force and skill, easily and at some distance killing a man or a kangaroo. Also, each carries in his belt a boomerang and a short club, for killing small game and birds. These they can throw with great precision.

There is much misinformation abroad concerning boomerangs, the general belief being that they return to the thrower; but the ordinary boomerang, the one used as a weapon, does not return; it revolves when thrown, and with such force that it can cut open a cheek or thigh if it strikes properly.

IT is a surprisingly effective weapon. Of course, some boomerangs do return; when we made it understood that we wished to see one, the whole camp was ransacked, only to produce two small, poorly made examples, not at all comparable to the handsome, efficient-looking boomerangs thrust under the belts of the men. To be returnable, the two halves, or blades, of the boomerang must be in slightly different planes.

So far as we could learn, those of the returnable type are used mainly as toys, because their movements are too uncertain to be depended upon to hit where they are aimed. However, in hunting water birds, they may be used to drive the flock toward the land and so within reach of the hunter, whereupon the birds are knocked down by the ordinary boomerang. One of the Blacks demonstrated with the returnable one; it sailed around somewhat erratically,

A CEREMONIAL TREE

On the trunk are mysterious symbols painted in red. Only those taking part know the meaning. Women are taboo

circling back, but not quite to the feet of the thrower.

Meanwhile preparations were being made for the sacred ceremonies to be held on the other side of the ridge. In the afternoon the men went to the ceremonial ground, giving us to understand that we could come later. After a time two old men came for us; we walked between them, abreast, while they beat two sticks together and sang songs; four times we paused for a few minutes, approaching the ceremonial place not directly, but circling clockwise. Here we found our friends standing in line around a tree, the trunk of which had been painted. As soon as we were in position, the ceremony proceeded; this consisted of dancing in a circle and finally rushing up to the tree. At the conclusion of the ceremony we returned to the camp, but not until the leader of the ceremony had laid upon us the injunction that none of their women should be told about what we saw.

THE natives were very anxious that we should stay for the festivities of the night—the "corroboree." Many writers speak of the "corroboree" as a sacred ceremony, but it is more in the nature of a social event. It takes place in the camp and all can join in, old and young. Before sunset we returned to the ranch house for a rest, and drove back to the camp after dark. As we neared the camp the Blacks waved burning branches to pilot us to the dancing ground. A space had been cleared of bushes and the roots grubbed up so as not to injure the feet. On the sides, brush had been piled, to be fired for tableau effects, for what good is a dance, if no one can see it?

Some old men, sitting in a row on one side, motioned me to a seat beside them on the sand. Most of the dancing was by women and girls; without clothing, their dark bodies painted with white lines, they danced in two files, holding their feet together and jumping up and down, in perfect unison, back and forth across the ground. The effect was barbaric but

A NATIVE HOME

The homes of the native Blacks are of a most primitive type of shelter built of brush

pleasing, and as a dance it was well executed. The old women and men sitting around, sang; while two men near me beat time upon the ground with their throwing clubs.

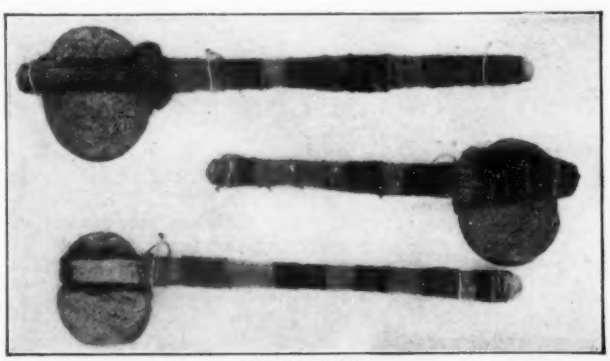
After the dance by the women, the men staged a few performances, one of which, representing the capture of an enemy, was especially successful. We greatly admired the way the evolutions were timed in the glare of lights when the piles of brush were lighted, and were sorry when the Blacks announced that the show was over.

THE different races of man have individualities. Experienced travelers feel these distinctions, but always find it difficult to express them. Entering a village of African Negroes, such an experienced person would expect the little community to react to his presence in the characteristic African way; visiting the Eskimo, a different reaction would be expected, but to put these experiences into intelligible words is impossible, because they are matters of feeling rather than of logical analysis. One can, however, discuss one experience in terms of the other. Thus, at first sight, the dark color and broad noses of the Blacks remind one of Negroes, but once in their camps the reaction of the group is not at all what one would expect from Negroes. Then, again, it is not like what one expects in a camp of American Indians, but the attitude of the Black is nearer that of the Indian than of the Negro. If, on the other hand, we compare the attitudes of all three with what we expect when entering a strange white community, then it seems that the Blacks are nearer to the whites than they are to the Negro or the Indian.

THE Australian head is narrow and long; the forehead is rather low and the brow ridges are bold and heavy, with the root of the nose deeply underset. The profile also shows the mouth thrust forward. Finally, the nose is broad and flat.

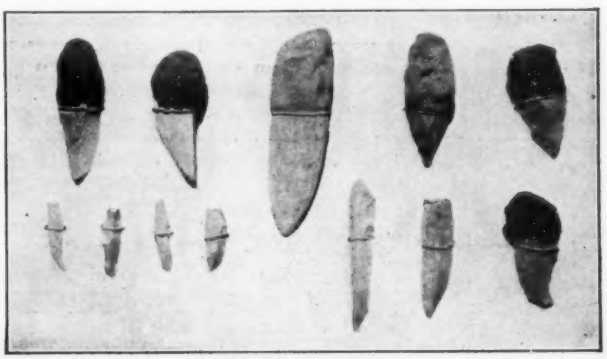
Comparative anatomists look upon certain of these traits as placing the Australian nearer the early ancestors of man than other living races. Nevertheless, the Australian is nearer the European type than the extinct forms of man, such as the Neanderthal, and in that sense is regarded as a modern type. If we reduce all this to a simple statement, its import will be that the Australian is a suggestion of what all men were at the beginning of the modern period, or to put it another way, in bodily and facial development he has not quite caught up with the other living races.

No evidence has come to hand indicating that any other people lived in Australia before the Blacks, while, on the other hand, there are indications that they entered the country a very long time ago and that no large amount of new blood ever reached the continent until the period of European settlement. So, for ages, the Blacks lived in relative isolation, untouched by the great culture changes and achievements in Europe and Asia. This may be one reason why they seem to us so barbaric and so crude, so reminiscent of what one conceives the Stone Age to have been.



STONE AXES

The men are armed with spears, boomerang and short clubs with stone heads attached as shown. The Black is very primitive in all things



STONE KNIVES

The native's fireside furnishings are almost nothing; a digging stick, a rude wooden dish, and stone flakes such as these to serve as knives

Our Point

The Public Will Be Confused

FIFTEEN enthusiastic men sailed northward in the *Italia*, under the gallant leadership of a man essentially without practical experience in the arctic. Of the deplorable losses which resulted the public already knows. Even experienced polar explorers lost their lives in the attempt to extricate the unhappy crew of the Italian airship.

The *Italia* was much too small for this undertaking. Her speed, 53 miles an hour, was also too low. Experienced arctic men warned the eager Italians of these facts. As a result of this misadventure, arctic navigation and exploration by means of the dirigible will inevitably suffer in the estimation of the public. Comparatively few will be likely to take the pains to differentiate the technical aspects of the matter. There will be a strong tendency simply to discredit the dirigible.

Plans have been matured by the "International Society for the Exploration of the Polar Regions by means of the Airship," generally known simply as "Aeroarctic," to explore the arctic next summer in the German dirigible *LZ 127*, under the leadership of the noted explorer Nansen. Dr. Nansen's practical experience in arctic life and travel is not limited to a flight across the top of the world, virtually as a passenger, on an air vessel which did not even touch the ice. The *LZ 127* is six times as large as the *Italia*—larger, even, than the *Los Angeles*. Her motors are powerful. Such a vessel will not be at the mercy of the rough environment of the north.

By no means let us permit the loss of the *Italia* to confuse us concerning the value of the dirigible in the arctic.

The Problem of Radio

FOR more than a year, the Federal Radio Commission has been contending with the stupendous task of untangling chaos in the ether, and attempting to bring peace and harmony to those whose business is to vibrate that all-pervading substance so that the general public may be provided with varied entertainment in their own homes. And, considering the obstacles to be overcome, and the total lack of precedent, they are, so far, making a creditable showing.

But the final radio Utopia is still far off. Even with the re-allocation of wavelengths, we still find that certain local stations are invariably accompanied by a heterodyne whistle that makes reception a nerve-racking ordeal.

When reviewing the situation, it must be borne in mind that the available wave channels for broadcasting are limited. We cannot go above 600 meters—there are the commercial stations. Below 200 meters are the amateurs and special experimental stations. We must not infringe their rights, for the amateurs are in a large measure responsible for the radio development of today.

Considering all this, there seems to be only one solution, composed of several parts. Some of the present, least essential, stations must go. Many of the smaller ones are now considering mergers. In this way, a transmitter of greater power and refinement could be erected with the pooled resources of the various managements, and the station could then be used for certain hours of the day or days of the week by each of the part-owners. Such a move on the part of several groups would at once alleviate present conditions, not only as to channel congestion, but also as to quality of programs.

Synchronization of wavelengths will also form part of the solution. By means of the quartz crystal or other method, stations in distant cities can operate on the same wavelength as a local, without any heterodyne interference.

The time is here when the American public demands, and rightfully, that they be given high-quality radio service. And the Radio Commission must produce more results. Their future actions will be watched with great interest.

A Word to the Wise

WITHIN five years a community, large or small, without its own aviation field is likely to discover itself as much of a backwoods anomaly as a community would be now without a public garage. Every evidence points toward a sudden expansion of civil aviation, pivoting on the notable aviation year 1928 when civil aviation received a fresh impulse and took on a new scale of importance. We now have 5000 civil planes. There was a time when we thought 5000 automobiles a large number. Here is food for thought. What will be the corresponding figure next year; and the next; and the next? If the future may be judged by the past, airplanes will increase in geometric ratio and nobody knows at what rate. It will not be as high as the rate of automobile increase from the year 1900 on, but it will be high.

If these suggestions are true, what should a wide-awake small community do? One way to handle the matter would be to wait until the air is full of planes. Many communities will do that. A few, however, will take care of future needs before they arise, and with scientific care and system. Those communities which do this are more than likely to profit later on in more ways than they can think of at present.

Preserve Our Lumber Sources

ECHOING far and wide, a bitter controversy has raged for the past few months regarding timber cutting practice in the national forests. Accusations and recriminations have flown with the wind: "Land has been denuded of trees indiscriminately;" "No, only the most suitable trees are cut;" "Private cutters are heartless;" "No, the larger companies are replanting as fast as they cut." Thus the battle rages.

Now that the question is in the public mind, some result may be expected on this score, but little has yet been said regarding the practice, by farmers and small owners throughout the country, of cutting the trees on their lands for firewood and local lumber needs. These people should be made forest-conscious. Public sentiment should show them the inadvisability of cutting every stick they own, all in a single operation. They should be converted to selective cutting and the practice of replanting religiously. No forest, no matter how small, should be completely stripped, and, unless the land is to be cultivated, the new growth should be regularly thinned out so that a new forest will rise as quickly as possible.

Europe has suffered a scarcity of wood for centuries but she has managed always to have just enough firewood and lumber. This has been made possible only because there are rigid tree cutting and replanting laws in force. Will such legislation be the final end for us? It certainly promises to be unless we, as individuals and as a whole country, mend our ways and decide to give the forest monarchs a chance.

# of View

Submarine Safety

SHORTLY after the *S-4* disaster, SCIENTIFIC AMERICAN received a letter from a reader asking that we bring to the attention of the Navy Department a submarine salvage device he had invented. Numerous others were received also, but this particular one stated that a private citizen has no chance of being heard, that the Navy Department apparently relegated to the waste paper basket all such voluntary contributions sent in by individuals.

Why does such an opinion persist? The department officials *do* welcome ideas presented by anyone, and gladly consider, solely on the basis of merit, any that come to their attention. One does not need "pull;" nor must he have his over-worked congressman or a magazine such as this present his brain-child for him. His idea, device, or invention will receive full consideration if forwarded directly.

In June, Dr. W. R. Whitney was appointed chairman of a special naval board called together to study carefully the 4150 suggestions relative to submarine safety and salvage that have been received since the sinking of the *S-4*. All letters addressed to the Navy Department on these subjects will be referred to this board which will remain in session for an indeterminate time. This is the answer of the department to those who have often accused it unjustly.

Forward!

BLINDNESS! Is there anything that prompts our hearts to a more instant response than the vision of one bereft of sight? Is there anything more inspiring than the blind cheerfully and courageously carrying on in their daily life, which often is a business life as well?

Twenty years of sympathetic, well organized, and directed effort has reduced blindness caused by ophthalmia neonatorum or "babies' sore eyes" among those admitted to schools for the blind, until it is now 64 percent less than in 1908. What a fine accomplishment for such bodies as the National Society for the Prevention of Blindness.

Great advance has also been made in sight-saving classes, pre-school eye testing and educational travel in the United States, Canada, and Great Britain, by devoted men and women spreading the gospel of sight-saving. Eye hazards in industrial occupations, constituting one of the most serious causes of blindness, (15 percent of the 100,000 blind in America) has also received special attention.

Much has been done, much is yet to be done, but what a gage of inspiration for future effort is the safeguarding of the eyes of the next generation, and the preservation of partial sight among those bereft of full vision! All honor to the late Dr. Hideyo Noguchi and his fellow workers; and, lest we be guilty of empty words, let our support of this consistent and organized effort be a tangible one to swell the coffers to carry forward a magnificent work.

No Billboards

THE Supreme Court of the state of Kansas has declared valid a statute enacted by the state legislature which prohibits any kind of signs, except official markers, on the right-of-way of any highway. It also prohibits the erection of any kind of advertising sign within 500 feet of a turn in the road, an intersection, or a railroad crossing.

A great deal has been said regarding this national nuisance and volumes more could be written, for the subject is one of disgustingly large proportions. We do not wish to discuss it, however, but to commend highly the state of Kansas for taking the leadership in this worthy campaign. Other states should take notice.

Valuable Marshes

DRAINING of marsh lands may not always be productive of good results, is the opinion of A. A. Saunders who has just published a study on the Montezuma swamp regions for the Roosevelt Wild Life Forest Experiment Station at the New York State College of Forestry, Syracuse University. On the contrary, swamp lands or marshes, drained so that the land may be used for agricultural purposes, often turn out to be worthless.

Such low lands may be the breeding places of valuable game and fur-bearing animals. Deprived of their natural homes, these animals may either die out or migrate to more favorable localities. Draining may also result in the lowering of water tables near the heads of streams, resulting in the drying up of springs and wells. Such a condition would add greatly to the forest fire menace and might tend to make adjacent lands less productive agriculturally. It is possible, too, that the seeping away of underground sources of water would cause an increase in temperature of surface streams to such a degree that they would be no longer habitable for fish.

While it is true that such conditions may be found in large measure in draining large areas only, there is danger that some of them may result from injudicious attempts to reclaim small marshes. In any case, natural conditions should not be disturbed until after the situation has been carefully studied from many angles.

Stop the Waste

ENORMOUS waste in industry results from the present practice of producing essential commodities in an arbitrary and haphazard array of sizes, models, and qualities. Often an article is manufactured in dozens or hundreds of sizes when only a relative few are necessary. The result is that the cost of production, which the consumer ultimately pays, is greatly increased, and the consumer is often uncertain that he gets just what he wants.

Arguing that the purchaser may buy an ounce or two ounces of a drug at a drug store but, rather than ask for 16½ or 17 ounces, would purchase a pound, a pound and a half, or two pounds, the American Engineering Standards Committee has tackled the problem of weeding out the unnecessary sizes. The committee would substitute a "preferred numbers" system in which, as sizes increase, the progression is in greater jumps on a regular percentage basis. It is said that the new system can be applied with a saving to almost every commodity from bread to machinery and from handbags to packing cases. The committee is also looking into the question of qualities and models with the purpose in mind of standardizing these so that purchasers may know exactly what they buy.

The committee's work as a whole is to be commended and its promotion of the "preferred numbers" system should have the support of every far-sighted person. One very great advantage that would result from the nation-wide adoption of this system would be the increase of the degree of interchangeability of goods manufactured in different parts of the country.

P and A

FRENCH SCIENTISTS HONORED

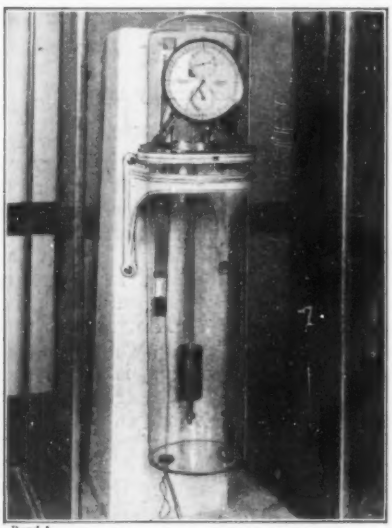
Dr. Negre (left) and Dr. Boquet, chiefs of the Pasteur Institute Laboratories, Paris, to whom the B. J. Rosenthal Prize of 25,000 francs and a gold medal was awarded for their work in tuberculosis research during 1927

P and A

SCREEN-TESTING THE VOICE

Pres. R. B. von Kleinsmid of the University of Southern California supervising a screen-test of the voice of Anita Page for "talking movies." The telegraphone shown here is being used in a series of such tests

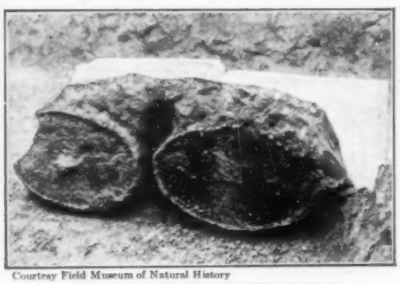
From the Scrap-book of Science



P and A

THE TIME OF THE NATION

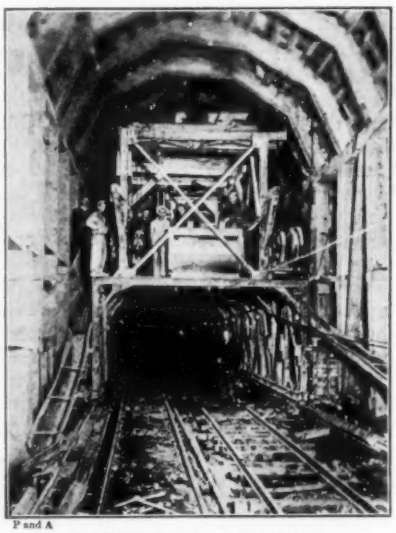
One of three clocks kept by the Naval Observatory in an underground, constant-temperature vault in Washington. A transmitting clock, set from one of these each day, sends out time signals. Air is partially exhausted from the sealed glass cases of these clocks, and the vault temperature is maintained at 84 degrees, Fahrenheit



Courtesy Field Museum of Natural History

OLDEST KNOWN WHEELS

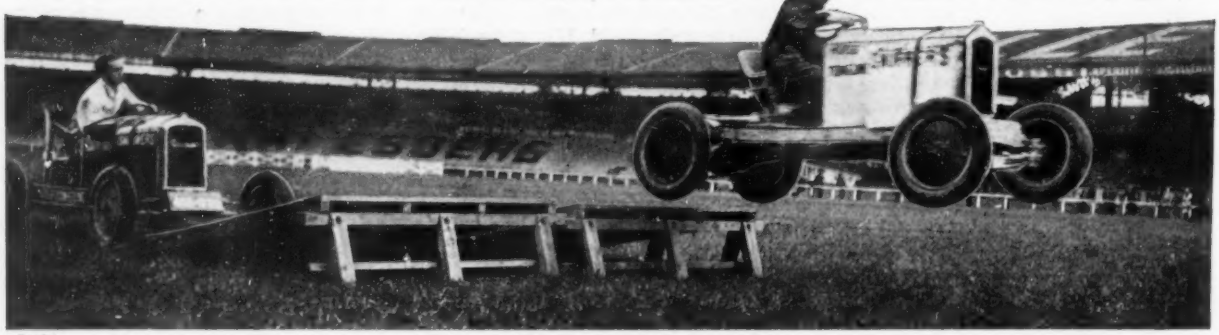
The Field Museum-Oxford University Joint Expedition unearthed these 5000-year-old chariot wheels at Kish. Apparently they were flattened by weight of the earth over them. The expedition has unearthed two four-wheeled chariots, and one two-wheeled one, all ancient



P and A

LARGEST U. S. TUNNEL

President Coolidge recently touched a button that set off the last blast that completed the Cascade Tunnel of the Great Northern, through the Cascade Mountains. It is eight miles long and will shorten the transcontinental trip by 50 miles. The photograph shows the lining machine which follows each blast and lines the bore as fast as it is made



P and A

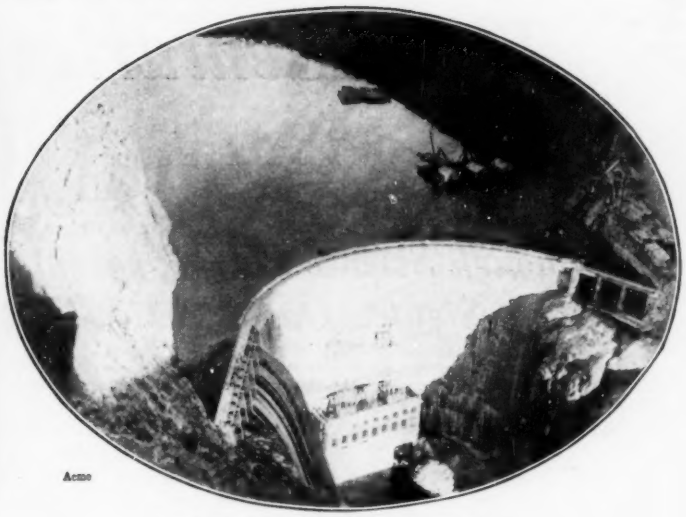
TAKING THE HURDLES IN HIGH

Not to be outdone by the airplane, the automobile now takes to the air. André Mercier, famous French automobile dare-devil, is shown just after a take-off from an incline in a car rated by the French at five horsepower

Underwood and Underwood

10,000,000 POUNDS COMPRESSION

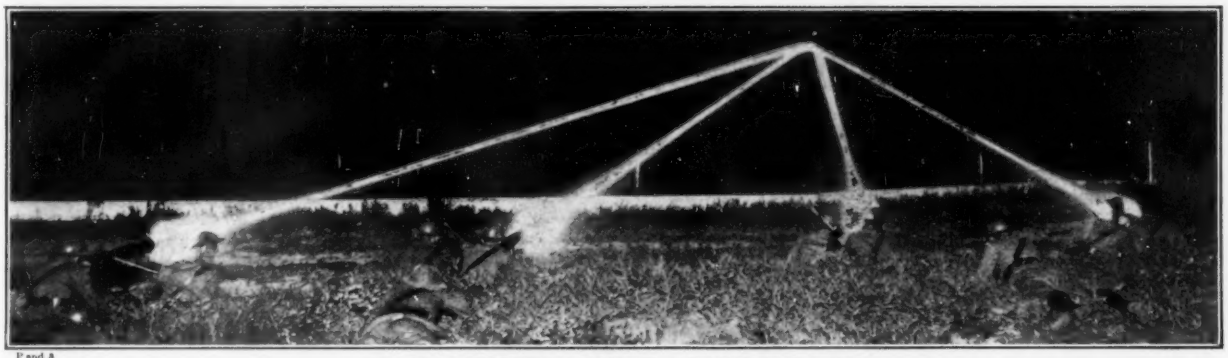
H. L. Whittemore explaining to a group of visiting New York skyscraper men how the Bureau of Standards tests building materials. *Above:* a 10,000,000-pound compression machine



Acme

FOR IRRIGATION AND POWER

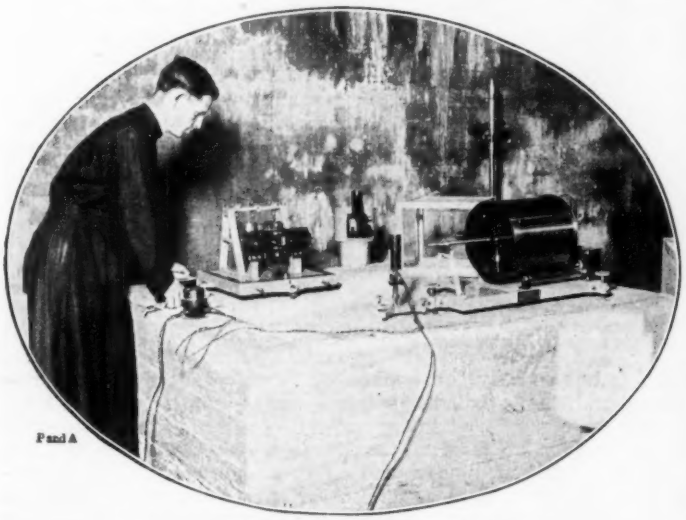
The newly-completed Horse Mesa Dam in Arizona, 305 feet high and 784 feet across its crest, impounds the Salt River to supply water for irrigation and to generate 40,300 horsepower at the toy-like power plant at its foot. This dam is 65 miles east of Phoenix



P and A

TRACER BULLETS AGAINST A DARKENED SKY

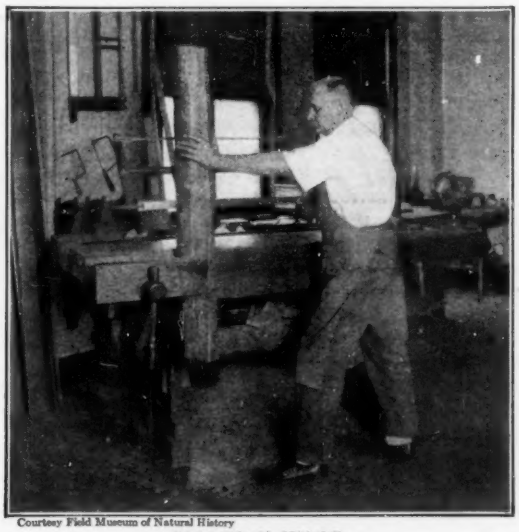
Spectacular night "warfare" recently conducted by R. O. T. C. cadets at the University of Missouri. This unique time-exposure photograph shows tracer bullets from machine guns converging to a point on a distant target



P and A

CATCHING AN EARTHQUAKE A DAY

With the three new Willip Galitzin seismographs imported from Esthonia and now installed at Fordham University, New York, Father John Tynan expects to record at least one earthquake a day where formerly he caught an average of 10 or 12 a month



Courtesy Field Museum of Natural History

"MAGIC" WOOD

One of only two specimens in the world, this bloodwood cacique log has been placed on exhibition in the Field Museum. The Indians of Panama attribute magic powers to the wood

Three Centuries of Natural Philosophy*

Although Science Has Apparently "Come of Age," Only the Short-Sighted Dare Predict That It Has Passed Its Vigor

By W. F. G. SWANN, D.Sc.
Director, Bartol Research Foundation of The Franklin Institute

(Concluded from August issue)

THIRTY years ago was a time of great depression in physics—a time when would-be Ph.D's went about like roaring lions seeking something to measure and finding nothing but the density of a gas or the viscosity of a solid. The sentiment of the times was well voiced by a certain European physicist of eminence who stated that it was probable that all the important experimental discoveries in physics had then been made and that henceforth the investigator must confine himself to a repetition of what had been already done with greater attention to minor matters of precision.

EVEN in those days the apparatus cases of most laboratories contained curiously shaped glass tubes containing rarefied gases of various kinds which could be made to glow in fantastic manner by sending an electric discharge through them. Few sought to penetrate the mysteries of those tubes. They would be brought forth on the occasion of popular exhibits in the laboratory, made to go through their alluring performances and then returned to their cases to await the next festivity of the kind. They were not viewed as serious articles of scientific research, but were considered as hardly more than toys.

And yet, what a marvelous secret they held! For it was in one of those tubes that, in 1898, J. J. Thomson discovered one of the two fundamental bricks out of which the universe is built—the electron—the tireless worker whose home is in the atom—the thing whose quivers send us light from the sun, whose ceaseless flight around the atom's center gives the magnet the power to pull—the thing whose motion through the electric cable constitutes the electric current—the thing whose splash when hurled into the atom with great speed is the X ray—the thing whose motions in the antenna send us wireless waves, and whose motions in the radio tube enable us to detect those waves.

It is to the electrons that matter owes all its chemical properties. It is electrons from the sun which are responsible for the aurora. The atoms of which matter is composed are so small that about a hundred million of them laid in line would take up but the length of one third of an inch, but the electron is so small that even in comparison with the atom it is but as a fly compared with a cathedral. It is so light that if everything were magnified in mass so that the electron attained a mass of four ounces, that four ounces would, on the same scale of magnification, become as heavy as the earth.

Courtesy General Electric Company

X-RAY DIFFRACTION APPARATUS

The modern form of the apparatus for studying by means of X rays the atomic structure of matter, as mentioned in the text. Most substances prove to be crystalline

Before the discovery of electrons we had cause to believe that there were such things as atoms and molecules, but nobody ventured to picture their structure, and we felt we had gone far in penetrating nature's mysteries when we were able to say that, on the basis of certain plausible considerations, it was probable that if a drop of water were magnified to the size of the earth, the molecules would become as large as small shot. The discovery of the electron gave a fresh impetus to man's hope of understanding the atom, and before long the second fundamental brick of nature's structure revealed itself—the fundamental unit of positive electricity—the proton, whose natural home is in the nucleus, the heart of the atom. The proton is 2000 times as heavy as the electron but it is 2000 times as small, so that if the proton were magnified to the size of a pinhead, that pinhead would, on the same scale of magnification, attain a diameter equal to the diameter of the earth's orbit around the sun.

AT the end of the last century Roentgen discovered X rays. The property by which they first claimed attention was their power to pass through flesh and so show shadows of the bones of the body. Soon, however, it was realized they were endowed with many other properties of a most important and interesting kind, properties which were bound up with the atom's structure and whose study therefore served to throw further light upon that structure.

Until the end of the last century, one of the most firmly established beliefs was that of the permanence of the atoms. However, near its close, Becquerel found certain curious properties of uranium oxide which suggested that this substance was continually emitting some kind of a radiation which could pass through screens opaque to light, and affect a photographic plate. Several other substances were discovered possessing this property, and many other characteristics of these substances were discovered, characteristics which could only be harmonized on the belief that the atoms of these substances were in a continual state of spontaneous dis-

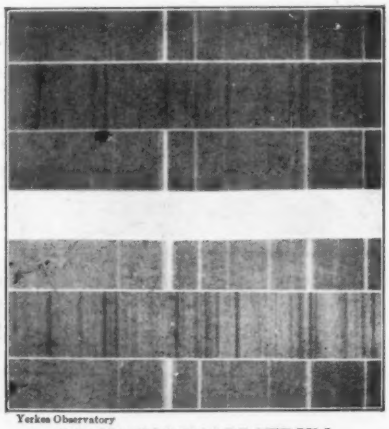
*Founders Day Address, Swarthmore College. From *Journal of The Franklin Institute*

integration—of atomic explosions if you will, and that the phenomena observed were the symbols of these explosions.

One may naturally be led to inquire how far discoveries in pure physics and mathematics find their reflections in the things of everyday life in the sense which we call useful. If in a great city we should set out on our travels with the intention of visiting all the places within the field of our immediate interests to the exclusion of others, and if we should refuse to walk along any street which did not itself contain many of these places, then, even as regards those things to which our interest was confined, we should limit greatly the possibilities which that city opened to us. If this is true of a relatively simple structure like a city, how much more is it true of that beautiful framework of science whose parts are so clearly interwoven that it is almost impossible to touch one of them without producing response in all the others.

WHILE, therefore, the man of science must pursue knowledge for its own sake, it is a remarkable fact that practically all of those achievements in the physics of the past 20 years which might be classed as utilitarian, have arisen directly from, or in relation to investigations pursued with no utilitarian motive directly in view. X rays revealed themselves first in the light of their importance in surgery. The study of their properties shed a new light upon the structure of the atom and this light was reflected back with enhanced intensity to clarify the properties of the X rays themselves.

The immediate application to photographic surgery was obvious, but that field which is concerned with the effects of the rays upon the body tissue, upon the cure of cancer and the like, was not so evident. Bound up as it is with the properties of the rays in relation to their passage through matter, with their absorption in the tissues, and the extent of the molecular disruption which they produce, it must draw for its development upon the more fine-grained aspects of the study of X rays which the physicist has made in the field of his own interests.



Yerkes Observatory

COMPARISON SPECTRUM

The motion of the star is shown by side-wise displacement of the middle bands

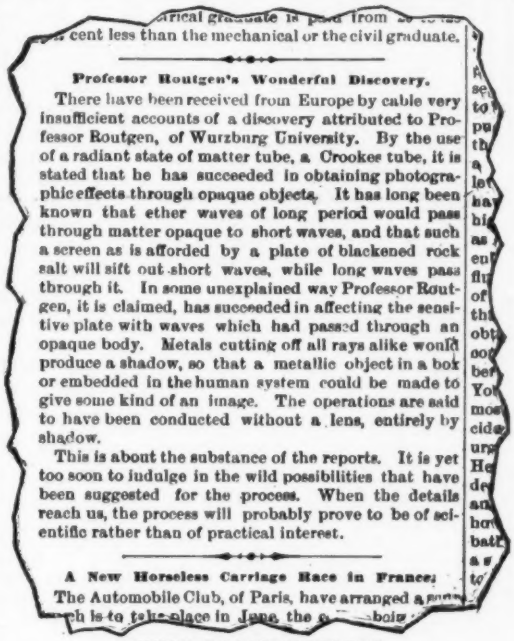
The study of radio-activity has taught us that in the spontaneous disintegration of the atoms which accompanies this process, powerful radiations are emitted. First we have the alpha particle, a positively charged atom of helium, with a velocity of 18 miles per second. Then we have electrons traveling with a velocity 10 times as large and finally we have a very hard type of X ray known as gamma rays. These rays possess the power to disrupt molecules through which they pass and it is this power which gives them, in common with X rays, such great value in medicine. The surgeon's knife can dissect the tissues and remove the larger malformations of growth, but the X rays, the rays from radium, and those of ultra-violet light can dissect the malformation on things 10,000 times smaller than the smallest things which our microscope can reveal.

The detailed investigations of phenomena pertaining to the passage of electricity through gases—phenomena whose study led to the discovery of the electron, necessitated an improvement in our methods of producing high vacua.

THE pumps of today can accomplish in 15 seconds what would have taken a couple of hours 25 years ago, and the vacua attainable are 20,000 or more times better than they were in those days. We can now reduce the pressure in our apparatus by means of modern pumps to such an extent that only one in every hundred thousand million of the molecules originally present remains.

This improvement in the technique of producing high vacua, rendered necessary for investigation in pure science, has rendered possible the electric lamps which we use today. It has rendered possible the modern X-ray tube—an instrument not only infinitely more reliable than the weak and capricious tubes of 20 years ago, but controllable in intensity to amounts 20 times as great as those formerly attainable. It is only through the aid of modern vacuum technique that the modern broadcasting station has been rendered possible, that the radio amplifying tube has become a reality, and that we can have wireless transmission of signals, speech, and photographs.

If, 20 years ago we had wished to give an example of a type of research which was least likely to have an utilitarian value, we could hardly have chosen a more fitting example than the investigations which Professor O. W. Richardson had been carrying on in England, and later at Princeton, on the emission of electrons from heated wires; yet it is to these investigations, combined with the power to produce high vacua, that we owe the modern radio tube, the X-ray tube, and a variety of appliances used in the general fields of radio transmission and X-ray technique.



cent less than the mechanical or the civil graduate.

Professor Routgen's Wonderful Discovery.

There have been received from Europe by cable very insufficient accounts of a discovery attributed to Professor Routgen, of Wurzburg University. By the use of a radiant state of matter tube, a Crookes tube, it is stated that he has succeeded in obtaining photographic effects through opaque objects. It has long been known that ether waves of long period would pass through matter opaque to short waves, and that such a screen as is afforded by a plate of blackened rock salt will sift out short waves, while long waves pass through it. In some unexplained way Professor Routgen, it is claimed, has succeeded in affecting the sensitive plate with waves which had passed through an opaque body. Metals cutting off all rays alike would produce a shadow, so that a metallic object in a box or embedded in the human system could be made to give some kind of an image. The operations are said to have been conducted without a lens, entirely by shadow.

This is about the substance of the reports. It is yet too soon to indulge in the wild possibilities that have been suggested for the process. When the details reach us, the process will probably prove to be of scientific rather than of practical interest.

A New Horseless Carriage Race in France.

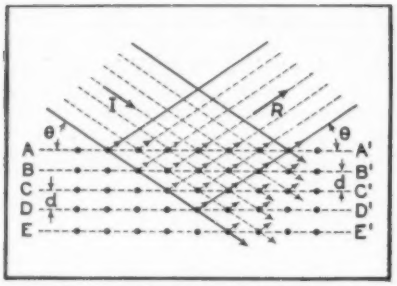
The Automobile Club, of Paris, have arranged a

"WILD POSSIBILITIES"

This little note is reproduced from the SCIENTIFIC AMERICAN, *January 25, 1896. It contains evidence that Roentgen's name was not yet widely known to the world*

MANY years ago, Rowland, of Johns Hopkins University, showed us how to rule very fine, closely spaced parallel lines on speculum metal and use them to analyze light into its component colors. That which the grating does to the light can be predicted if we know the spacing of the lines; and, conversely, if we had known beforehand the nature of the light, we could have gained information regarding the spacing of the lines. Since

It has long been known that light when falling upon the surface of certain substances possesses the power to eject electrons from them, and the study of this phenomenon has been one of primary importance in relation to our knowledge of atomic processes. But it, too, has had its practical application, for it is this phenomenon which has rendered possible the wireless transmission of pictures, and a variety of other things hardly less important even though less spectacular.



X-RAY DIFFRACTION THEORY

Incident beam I is reflected at a definite angle. Beams from successive atom layers reinforce one another if in like phase. The wavelength being known, the atomic spacing may be calculated from the angle of reflection

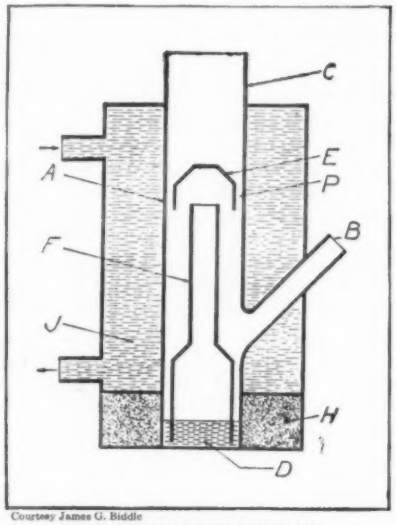
X rays are of the same general nature as light, but of much shorter wavelength, it became a matter of interest to inquire how far such methods could be applied to them. It soon appeared, however, that for the successful pursuit of this problem, it would be necessary to rule lines whose distance apart was of the order of one-hundred-millionth of a centimeter.

We cannot, of course, make such ruling, but nature has provided us with something very like them in the regularly spaced atoms which constitute a crystal of rock salt, for example. About 15 years ago, Laue found that he could make a crystal act in relation to X rays in very much the same way as Rowland's gratings acted toward light. The matter was pushed rapidly forward by a number of physicists, and soon gave accurate means of measuring the form of distribution and spacing of the very molecules of the crystals.

IT is quite impossible in a short space to give any idea of the tremendous field of activity which these discoveries opened up in relation to atomic structure on the one hand, and the nature of X rays on the other. Not only this, but it soon became realized that there were other fields of usefulness for the new method. Not the least among these has been its application to the structure of metals, which has provided the metallurgical engineer with a new method of attack in the detailed examination of his alloys, and of the effect of strain and other treatment upon them. Whereas formerly the limits to the fineness of his examination were determined by what his microscope could see, he is now almost in a position to look at the very molecules themselves.

Many years ago, Professor Michelson, of the University of Chicago, became interested in the question of whether or not the velocity of light is affected by the earth's motion. This is an experiment having, at first sight, nothing but a philosophical interest. But Professor Michelson obtained an unexpected result, a result which did not harmonize with our understanding of nature's laws; and herein lay its great value, for it showed that our modes of thought required revision. This great revision, not, of course, in the laws themselves, but in the sense in which we interpret them if they are to harmonize throughout, constitutes the theory of relativity—a way of looking at things which soon made its influence felt outside of the domain in which it was born—a scheme of thought which has enabled us to see harmony in, and so understand, many wonderful things in the theory of electricity, atomic structure, and other branches of physics.

Moreover, here again we meet with a remarkable example of the interdependence of the various parts of science on each other. Of all branches of pure mathematics one could hardly conceive any farther removed from nature than those having to do with non-euclidean geometry, and the so-called



Courtesy James G. Biddle

HIGH VACUUM PUMP

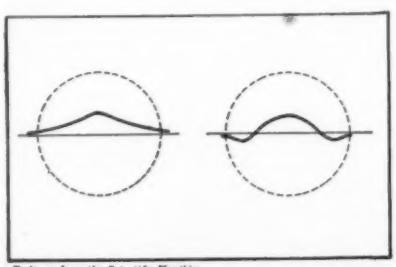
With no moving parts, the Langmuir mercury vapor pump creates a vacuum of one 10,000 millionth atmosphere. Mercury is boiled at D, passes through F and strikes cooled wall A. Gas enters C, is drawn into vapor blast at P and exhausts at B

absolute calculus of Ricci and Levi-Civita. These were fields so specialized as to be studied only to a very limited extent by mathematicians themselves. Yet, even as an archeologist might suddenly come upon a scroll of papyrus outlining the laws of an ancient civilization, and might therein find the means to harmonize and understand the other visual records which his search had unearthed, so Einstein found in these abstruse writings of the mathematicians the wherewithal to express the unity of nature's laws in a form so beautiful that he has likened that expression to a wonderful symphony of which our universe is the expression of God's rendering.

Astronomy, the most ancient of the sciences, has always occupied a place in the forefront of the imagination of the scientist and the layman alike. With the motions of the planets coordinated by Kepler, and moulded into a beautiful scheme of physical law by Newton 300 years ago, there seemed but little more that man could expect to discover. The growth of the science of optics soon provided a tool wherewith to explore farther, however. Laboratory studies of the nature of the light emitted by incandescent solids and gases soon provided a means of determining much concerning the heavenly bodies by a study of the light which they emit. Stars which are so far away that their light, traveling towards us at the rate of 186,000 miles per second, takes thousands of years to reach us, may move with great velocity without that velocity making itself apparent by direct observation. A study of their light has enabled us to determine their speed in very much the same way that we could determine the speed of a train by noting how much the pitch of its whistle is altered by the motion.

THE stars are so far away that even in our most powerful telescopes they appear but as points in spite of their great size; but by drawing in greater detail upon our knowledge of the way in which light comes to us and of the effect of the size of the emitting body on the character of the light, Professor Michelson, at an age when most men are content to rest upon their laurels, performed one of the most brilliant feats of a lifetime of masterly achievements in measuring the diameter of one of these stars, a feat equivalent to measuring the diameter of a penny at a distance of a thousand miles.

Strange as it may seem that we can learn so much about the stars which are so far away, the last few years has enhanced still further the wonder of it all. For the knowledge which we have gained about matter by experiment in the laboratory has found a most remarkable field of application in enabling us to understand the conditions which must prevail in the stars; and, these stars by their peculiar characteristics of large size, high temperature, high density, and so forth, have pro-



Redrawn from the *Scientific Monthly*

THE NEW ATOM CONCEPT

A purely imaginary, diagrammatic effort to convey a rough idea of the de Broglie-Schrödinger atom. The sphere varies in density perhaps as shown. The new atom concept involves both particles and waves

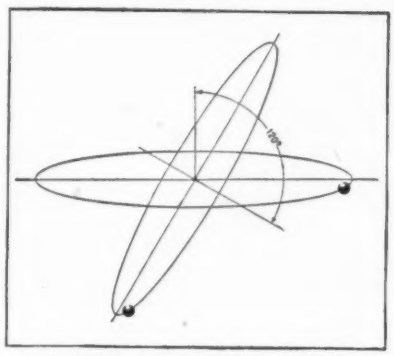
vided us with conditions to test our conclusions such as we could never have hoped to attain in the laboratory.

A gas compressed to a density 8000 times that of steel is but a figment of the imagination in the laboratory, yet of such stuff is the Companion of Sirius made. Temperatures of 40 million degrees correspond to things 10,000 times as hot as any temperatures we find on earth, yet nature has realized such temperatures in some of the stars. And so the stars, far from being things through which we dare hope to learn but little, have, by their exceptional condition, served to provide us not only with a very fascinating story of their own life history, but with a large part of the story of the birth of matter itself.

Discoveries in the fields of experimental science naturally go hand in hand with that study of the laws of design of the universe which we call theoretical science.

One supplements the other, and the strength of one enhances the strength of the other. It is naturally around the atom's structure that the thoughts of men have loved to hover. And here, the power to comprehend a new point of view has grown enormously in the last few years. We have a clearer understanding of what understanding means.

WE were in danger of becoming so enamoured of those laws which govern the behavior of matter in bulk as to refuse to admit any other possibilities in respect to the laws of the atom. The workings of the coarse-grained things of nature were all about us. Pulleys, springs, water torrents, the waves of the sea, these were things of common

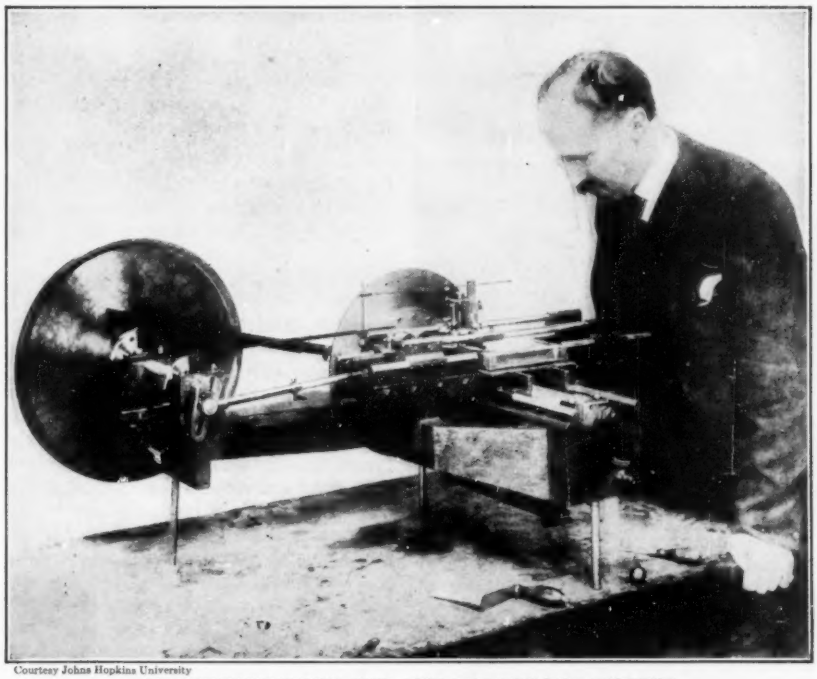


MODEL OF HELIUM ATOM

Kemble-Bohr model of an atom of helium, magnified about a thousand million diameters

experience, and the mind sought contentment in the thought that the atom might utilize in its structure only things which behaved as these things behaved; and even as a little hill may hide the Alps from one whose life is in its shadow, so there was danger in the known and obvious workings of the common things around us obscuring from our vision the story of that great universe of the atom which lies beyond.

Happily, the complacency of our outlook has received, in recent years, one or two serious jolts. First came the theory of relativity, which taught us that a greater elasticity of thought was necessary if we were to understand nature as she is rather than as we might have made her. Then came a series of



Courtesy Johns Hopkins University

PROFESSOR ROWLAND AND HIS RULING ENGINE

This extremely refined mechanism rules diffraction gratings with a diamond point, putting six miles of minute parallel lines on a five-inch circle in 63 hours. Such a grating gives more accurate spectra than prisms, because errors due to the intervention of glass are eliminated

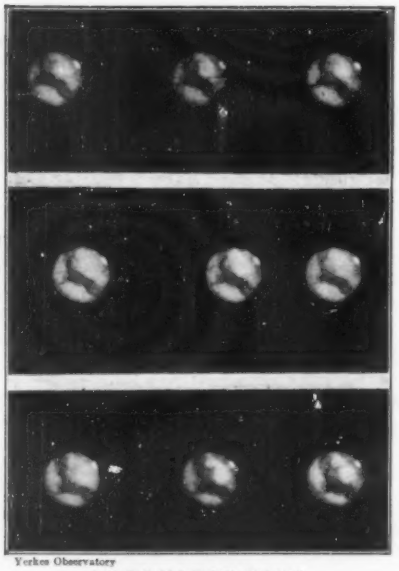
experimental phenomena which seemed to violate all our notions of how things should be, and since we could not alter the experimental phenomena we had to alter the notions, and so there arose the so-called quantum theory of atomic structure—one of the most helpful crystallizations of thought for correlating the facts that we have ever had.

And then, as further search showed this theory to be inadequate beyond a certain stage, there arose only a couple of years ago, an entirely new way of regarding the atom—a way so radical in its point of view that it is safe to say that had it been put forward fifteen years ago, it would hardly have attained a hearing. Born in a day of more liberal thought, however, it had no sooner made an appearance than a host of workers arose to welcome it and to develop its consequences, so that today there is hardly a physical laboratory in the country which does not contain one or more people who have acquired the power to think in its terms.

In speaking of theories being discarded and superseded by others, we must not think of the discarded ones as useless. The situation is not so much one where we are to think of a certain theory as right and all the others wrong. In a sense, different theories are like different languages for describing the same phenomena. The English language may be more suitable—more powerful for the purposes of the science of chemistry than the French language. It may have a greater richness of word content; but to say that one is right and the other wrong is to utter nonsense.

And so, a quarter of a century after the prediction of the eminent European philosopher to the effect that discovery was ended we find ourselves in the most intensive period of scientific activity of all time. We may well ask where we are headed. Shall we continue to discover new treasures, or, when we have catalogued those we have, shall we reach again one of those periods of stagnation? If we do, and if there be any one who then feels that progress is ended, that knowledge is complete—and that science is dead, let him think of how confidently he could have voiced that same thought in the civilization of the Pharaohs. Let him think with what surety he would have voiced it in the years which followed Newton. Let him think how he would have voiced it—yes, perhaps how he did voice it 30 years ago, and then let him take hope.

For the words of the Bard of Avon are truthful yet. There is more in heaven and earth than is dreamed of in even twentieth century philosophy, and the richness of nature's content will not be fathomed in our time.



Yerkes Observatory

MARS IN ROTATION

The astronomer generally makes several exposures on the same plate. Here the three plates were exposed at 60 and 22 minute intervals, respectively

Animating Jupiter

For the First Time Direct Motion Pictures of a Rotating Planet Have Been Made—Astronomical Correspondence from England

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

THERE are some advantages from the standpoint of scientific meetings in living in a country of less than continental size. People can get together oftener. The National Academy of Sciences, for example, meets twice a year—once in Washington and once in some university town. The Royal Society meets every week, except in the summer.

One result of this is that on special occasions when visitors from abroad are present in numbers, the sessions of English learned societies are sometimes turned over almost entirely to their guests. For example, at the meeting of the Royal Astronomical Society a few days ago, every speaker came from overseas, our English colleagues generously foregoing the chance to present their own work which was left to be "read by title" and published later.

THE principal event of the day was the George Darwin lecture which was given by Professor W. H. Wright of the Lick Observatory. Some of the admirable photographs of the planets which he exhibited are already familiar to American astronomers, but the most noteworthy of them were altogether new.

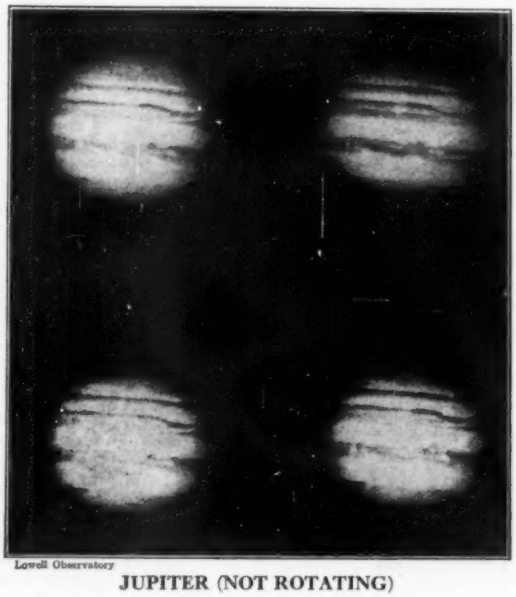
We are familiar with the "speeded up" moving pictures which show, for example, the opening of a flower before our eyes, but no one before Professor Wright has had the audacity to think of moving pictures of the rotation of a planet. Jupiter, which completes a rotation in a little less than 10 hours, was chosen for this bold attempt. Only in such a climate as that of California could there be any chance of success, for photographs must be taken at regular intervals of a minute or two all night long—or at least so long as the planet is high enough in the sky to observe satisfactorily. Even so, no single night's work suffices to follow a whole rotation, and two or three successive nights are required before every aspect of the planet has been recorded.

Extraordinary care and eternal vigilance must be exerted to see that the planet's images are all in correct register so that the final image on the screen does not oscillate, but this problem like others has been solved, thanks to the co-operation of Professor Wright and Dr. Mees of the Research Laboratory of the Eastman Kodak Company.

A CAPACITY audience in the historic rooms of the Royal Astronomical Society watched the first showing of the films and broke into the heartiest applause. The diversified surface of the planet was shown in clearest detail and the steady rotation showed itself so simply and naturally that it was hard to realize what pains and labor had gone to speeding it up a thousand times until it became conspicuous to the eye. The Great Red Spot and the smaller details of the surface passed in stately procession across it. At one point in the revolution a satellite appeared at the side of the screen and advanced rapidly toward Jupiter. Just before it reached the planet the shadow of the satellite entered upon the disk, followed a moment later by the satellite itself which in contrast to the black shadow appeared as a pale greyish spot.

These pictures form the most remarkable presentation of the actual progress of stellar motions which has ever been shown. When and how they may become available to a larger public, the writer of these lines does not know. It is greatly to be hoped that they may be widely exhibited and, if they are, that all who are interested in the heavens will take the opportunity to see them.

At the same meeting Dr. H. Spencer Jones, who is Royal Astronomer at the Cape of Good Hope, gave an interesting account of the latest observations of Nova Pictoris. The rings which have been reported as seen about the star's image on certain photographs appear to be of instrumental origin, for different telescopes show them of quite different sizes. They probably arise from the peculiar character of the star's spectrum which is rich in bright lines.



Lowell Observatory

JUPITER (NOT ROTATING)

The hazy edge of the photographs is due to the planet's dense atmosphere. Jupiter rotates in 9 hours, 55 minutes

If the light of some of their wavelengths is not brought by the lens to exactly the same focus as the rest, the observations are explicable. With powerful visual telescopes, however, the nova itself has appeared double and more recently triple; in fact a fourth very faint component has been suspected. All these objects appear as condensations in a small oval patch of light and the whole affair is so small—

less than a second of arc across—that only a large telescope will resolve the details at all, and that under the best seeing conditions alone.

What these extraordinary observations mean, no one dares to suggest. It is not yet certain whether some unusual optical disturbance of the image may not be at work, and any attempts at theorizing or at talking of a star "breaking up into parts" do not find favor with the judicious. It is clear, however, that we have here to do with one of the most interesting novae upon record and future developments will be awaited with great interest.

ANOTHER excellent piece of work by Dr. Jones which has recently appeared may well be described at this time. The bright star Procyon has long been known as an interesting binary. The discovery that it was double was not made by direct telescopic observation but as a result of the discussion of a century's observations of its position in the heavens. For so bright a star, observations of the right ascension and declination have naturally been numerous. These show that it is moving in the heavens at the unusually rapid rate of 1″.24 per year. A single set of good observations should fix the star's place with an average error of about 0″.3, so that a single year's interval would suffice to show that it was moving.

But when a long series of observations were collated, a strange thing appeared. The star was not moving in a straight line but in a wavy curve. A straight line (to be exact, a great circle on the celestial sphere) can be drawn so as to keep close to the actual observed track, but the latter oscillates back and forth across it, deviating to a distance of about 1″, which is very much greater than could possibly be explained by any errors in the observations. The only reasonable explanation was that the star must be double, having a companion so faint as to be invisible in the telescopes which then existed.

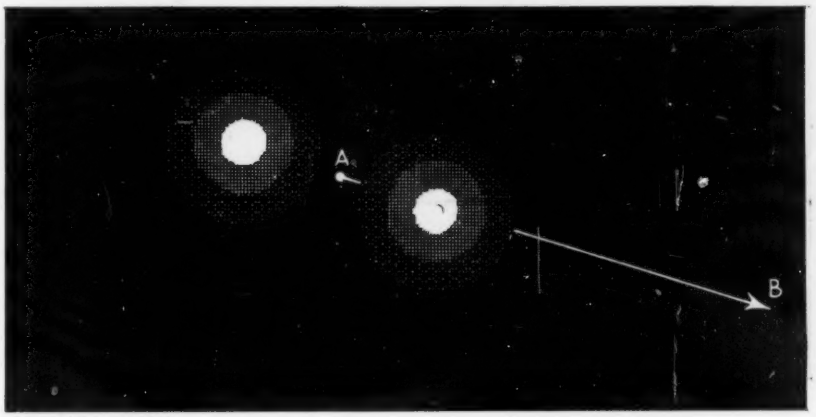
The center of gravity of Procyon and its faint companion would move uniformly in a straight line; but the bright star itself circulating about this center would move in a wavy curve. The star came back to the same part of successive waves of the curve in 40 years' time, so that this was evidently the period of the orbital motion.

All these facts were brought out by the great German astronomer Auwers when a young man, in 1862. Since then the star's motion has continued to follow the same wavy curve.

But why was the faint companion not seen? The answer came in 1896 when Schaeberle, with the great Lick telescope, detected a tiny attendant a little less than 5″ from the bright star. It was so faint that it taxed the powers of the 36-inch instrument and the failure of observers to see it with smaller telescopes was at once explained.

From 1896 to 1914 it was followed by several observers and found to move steadily around Procyon in the direction indicated by Auwers' calculations. Then it gradually drew nearer to its primary and for the last dozen years it has been invisible, lost in the glare of the bright star. According to the latest estimates the companion is less than one one-hundred-thousandth part as bright as Procyon, so that no one could expect to see it close to the latter.

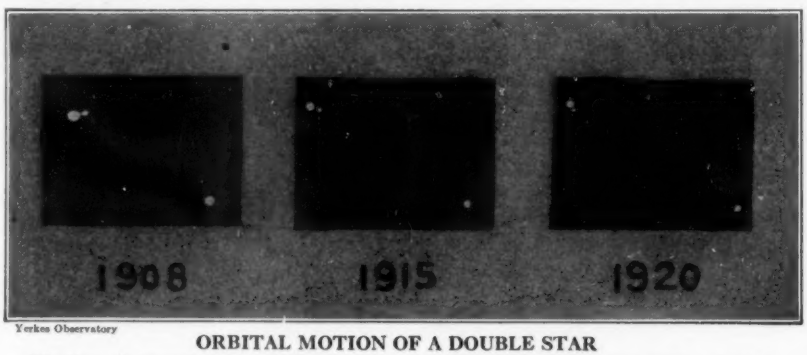
To work out the exact orbit of such a system is a hard problem. The micrometer measures of the companion cover but a part of the orbit and are not very accurate on account of its faintness. The observations with the meridian circle which extend from 1755 to the present, cover more than four complete revolutions. But when the computer starts work upon them he must take all sorts of precautions. The minutest errors must be found and eliminated, much calculation must be done, and a final solution reached.



Courtesy of *Discovery* (London)

APPEARANCE OF NOVA PICTORIS ABOUT APRIL FIRST

The rings are thought to have resulted from the use of a lens corrected for the blue end of the spectrum. Thus the other colors were out of focus, and each color caused its ring



Yerkes Observatory

ORBITAL MOTION OF A DOUBLE STAR

The three photographs of the star Kreuger 60 were taken, respectively, in 1908, 1915 and 1920. During that period of time the faint companion's position angle changed about 90 degrees

SUCH work is exceedingly laborious. The mere account of Dr. Jones' work containing only the observational data on which it is based, and a general summary of the methods and results, occupies nearly 40 pages. The original calculations would make a far larger pile.

At the end after a full consideration of all the various data he reaches highly satisfactory results which account for the whole observational material accumulated during 170 years. The period of the companion "O" motion is 40.23 years; its mean distance 4″.26; the eccentricity of the orbit 0.310, and its inclination 30°.6.

The parallax of Procyon has been accurately observed, and it follows that the mean distance of the companion is actually just a little less than 14 times that which separates the Earth and the Sun, and therefore almost half between those of Saturn and Uranus. The mass of the brighter star is 1.24 times the Sun's, so that it is a good deal like the latter, though somewhat heavier, hotter and brighter. The companion has but two fifths of the Sun's mass. Even this is unusually large in proportion to its brightness and it is probable that it is a "white dwarf" like the Companion of Sirius which behaves similarly.—*London.*

Taming

Unique Concrete Withstand

BANK OF SANTA CLARA RIVER AFTER A RAMPAGE

After the flood waters of the storm of February, 1927, had subsided, a great slice was found to have been cut from the bank. The tetrahedrons were installed here to prevent further cutting

THE recently completed river-bank protection at the western end of the Santa Clara River state highway bridge near Montalvo in Ventura County, California, although damaged and badly displaced by the terrific flood resulting from the failure of the St. Francis Dam, proved effective and prevented damage to the state highway, to the Southern Pacific Railroad and to the abutting property, which, without this protection, would have amounted to many times the original cost of the bank protection.

Except for the line of defense made by these reinforced concrete tetrahedrons, the rushing flood waters would have washed away many acres of fertile ground on the west bank of the river and would have washed away the earth embankments at the west of the state highway bridge and of the bridge on the main Coast Line of the Southern Pacific Railroad.

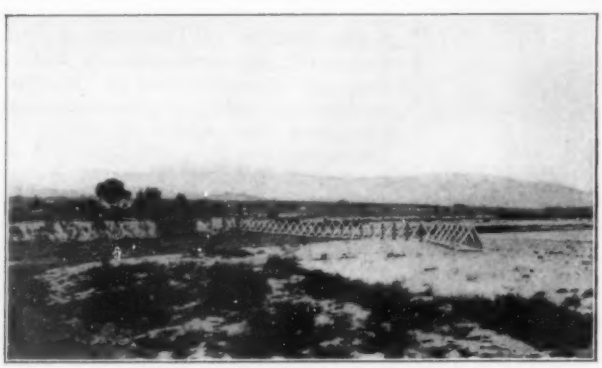
Standing directly in the path of the torrent, the bank protection, consisting of a row of 30 reinforced concrete skeleton tetrahedrons extending out from the river bank to deflect flood water under the main bridge and to protect the west approach, was struck by a wall of water 15 feet high. This wall of water carried with it a mass of large, uprooted trees, telephone and power poles, and portions of buildings and barns which had been destroyed by the flood. This battering ram was at work for several hours in its attack on the westerly approaches of the highway and railroad bridges. The force of the rushing waters was so tremendous that the entire row of 30 tetrahedrons, weighing over 200 tons and laced together with seven lines of one-inch cable, was swung back 150 feet toward the river bank at the downstream end, pivoting about the heavy concrete anchor at the bank on the upstream end, which held firm.

SIX of the 30 tetrahedrons—those located most centrally in the low water channel and which had become partially imbedded in the river bottom during a previous high flow of water—were torn to pieces by the torrent, which snapped and broke the 12-inch by 12-inch heavily reinforced concrete legs. Since their bases were imbedded in the sand and they were fastened to adjacent tetrahedrons with seven lines of cable, these six were pulled apart as the 14 tetrahedrons below them were swept toward the river bank.

With six broken and the others badly displaced, the row of 30 concrete skeleton tetrahedrons successfully resisted the most tremendous flood that ever rushed down the river channel. The earth approach to the west end of the bridge was not damaged, for the water was deflected by the tetrahedrons to its proper course under the bridge. Large quantities of brush and trees were collected by the protection work, and the area remaining between the row of tetrahedrons and the river bank and also on the stream side of the protection was silted up with about four feet of sand and gravel, thus straightening the channel and leaving conditions better than before the flood as far as the river channel was concerned.

So great was the flow of water that it topped the bridge floor by more than a foot and carried away 240 feet of the pile trestle approach to the bridge, including all of the reinforced concrete pile bents except the westerly shore span. A hundred feet or more of the bridge deck was thrown up high on the west river bank, where it lay for some time intact, 300 or 400 feet from where it was displaced.

If the Santa Clara River were allowed to choose its own course, it



COMPLETED PROTECTION WORK

The line of unique concrete forms installed and anchored to the bank at about the point from which the photograph at top of page was taken

AFTER FAILURE OF ST. FRANCIS DAM

When the flood waters swept by, the tetrahedrons were twisted but the area behind them was raised about four feet by a soil deposit

a Turbulent Torrent

Forms for Preventing Disastrous Erosion St. Francis Dam Break Flood

By E. T. SCOTT
Engineer, Division of Highways, California

would most likely meander out of its regular channel, in a manner similar to that of the Mississippi, rather than flow under the 2077-foot state highway bridge near Montalvo. On several occasions during the last few years the river, swollen by flood waters, has swung sharply to the west, cutting away the 15-foot embankment on that side of the river and destroying several acres of agricultural land.

During the storm of February, 1927,

POURING CONCRETE

Concrete for the top was poured by means of a teeter beam. Note sheet-iron corner forms

the river took another swing to the west at a point about 1200 feet upstream from the state highway bridge and continued to wash away the high river bank until it threatened to cut through the west approach to the bridge. Only the vigorous action on the part of the maintenance organization prevented the highway from being washed out.

The trees, cable, and brush used successfully by the maintenance crew during the storm, in preventing the flood waters from cutting through the highway, offered but a scant barrier to further inroads from the stream during floods of the winter to follow. Studies were made to determine the best means of bank protection for the particular case. An inspection made of various types of bank protection work used on the Santa Clara River showed that the only type of permanent bank protection that had successfully withstood the floods was the concrete skeleton tetrahedron.

This form of protection to control the river was first employed by Dan Sheldon, a rancher who has owned and operated for many years a 400-acre ranch immediately north of the state highway and located along the west bank of the river. As long ago as 1912, Mr. Sheldon constructed and placed at strategic points along the river, concrete tetrahedrons which he invented and which have since been most successful in controlling the flood waters of the river adjacent to his property.

STANDING 13 feet high, composed of six 16-foot legs a foot square, well reinforced with steel, and weighing about seven tons each, these forms are capable of withstanding a tremendous force.

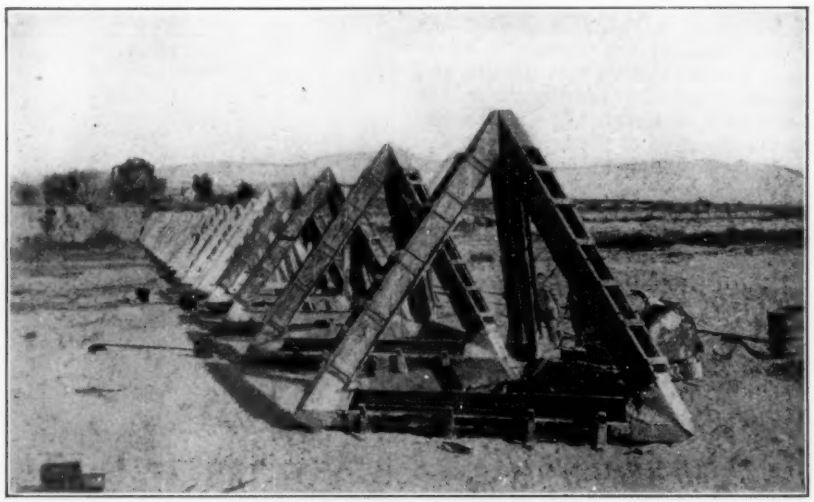
Should the tetrahedron be undermined or even toppled over by the flood, it still stands on a broad base, always offering a resistance to the onrushing water. Several years ago one of the heavy tetrahedrons standing at the end of a row, and not cabled to the adjoining tetrahedrons, was washed a quarter of a mile downstream by the flood. It took hours for the heavy concrete figure to cover the distance because each time it rolled to a new

ASSEMBLY OF REINFORCEMENT

Reinforcing rods were assembled in position before the concrete forms were constructed

one of its four similar bases, it stood upright, always resisting the force of the river. After the storm the strayed tetrahedron was dragged back to its place with a tractor, having suffered no damage during the trip.

A large amount of driftwood and brush is carried by the Santa Clara River during flood times. Soon the drift begins to accumulate against the row of concrete tetrahedrons which are now laced together with cables. As the tangle of brush increases, the swift current of the river is retarded a little, and the silt and sand carried by the water begins to drop and accumulate



THE ROW NEARS COMPLETION

A man may be seen directly behind the first tetrahedron of the row which is anchored at the farthermost end. At this stage the deepest part of the low water channel had been crossed

PROOF OF THE EFFECTIVENESS OF THE WORK

Debris brought down by flood waters, was caught by the forms and served to assist in holding back the flood. Although some of the tetrahedrons were damaged, they were effective

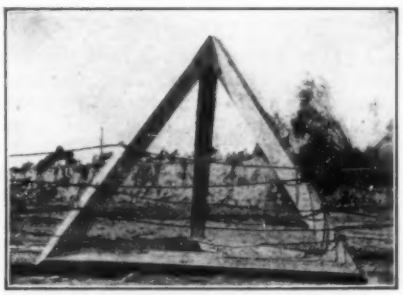
both above and below the obstruction to form a strong wall, and the river veers back to its old channel.

In order adequately to protect the highway embankment leading to the bridge and force the river over toward its old channel, a row of 30 of these concrete skeleton tetrahedrons, placed approximately 19 feet apart from center to center, was constructed along the west bank of the river on the upstream side of the bridge. Nearly 600 feet in length, this row was installed at an angle swinging downstream from the river bank so that it crossed a newly cut low water channel.

During the construction of this row, ranchers owning property along the east bank of the river over 2000 feet away, objected to the continuation of the work as originally planned, fearing that flood waters would be forced across the river to do damage to their property.

IN order to appease the complaining ranchers without lessening the effectiveness of the protection work, an angle was thrown into the line and the six tetrahedrons farthest from the bank were constructed at a right angle to the direction of the bridge.

In constructing these tetrahedrons, steel reinforcement consisting of eight one-half inch bars for each 16-foot leg, was assembled where the tetrahedron was to be constructed. The two outside corner bars of each leg were cut 17 feet, six inches long and, when installed in place, the ends were bent into and tied to the opposite corner bars of adjacent legs. The remaining six bars of each leg were 14 feet long and were placed so that their ends projected past the ends of bars in the other legs at the corners. A spiral reinforcement of Number 8 wire was then wound around the longitudinal reinforcing bars with a pitch of six inches. Sheet iron corner forms were then slipped over the reinforcing bars at the three corners of the base and wooden forms for the legs set in place. A sheet iron corner form similar to those used on the base corners, but



TIED TOGETHER WITH CABLES

Forms were tied together with old one-inch cable which was wrapped around the legs

having a small opening at the top to admit concrete, was used at the vertex of the tetrahedron.

Concrete was poured into the lower part of the tetrahedron directly from wheelbarrows. As the construction progressed, concrete was shoveled into the forms, while the last few cubic feet of concrete to be placed at the top was elevated by a bucket attached to a portable swinging teeter beam.

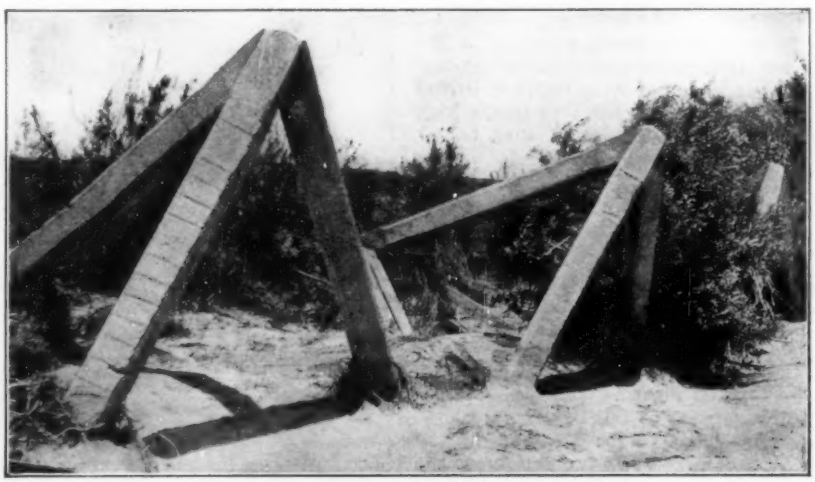
The completed tetrahedrons were placed with the 16-foot sides in line on the upstream side and the points of the equilateral bases downstream. A space of three feet was left between the corners of adjoining tetrahedrons on the upstream side.

Six lines of old one-inch cable secured from nearby oil fields, were stretched along the upstream side of the row and one line along the downstream side. The cables were fastened by simply wrapping them around the legs of the tetrahedrons and by the use of cable clamps. The purpose of the cable was to tie the whole row of tetrahedrons together so that they would act as a unit during a flood to catch and hold the brush and trees carried down by the storm waters.

AT the attached end of the protection work, the cables were cast into a large block of concrete which anchored them at a safe point to the river bank. Some brush was then piled near the bank to prevent any possible cutting away of the bank behind the protection work.

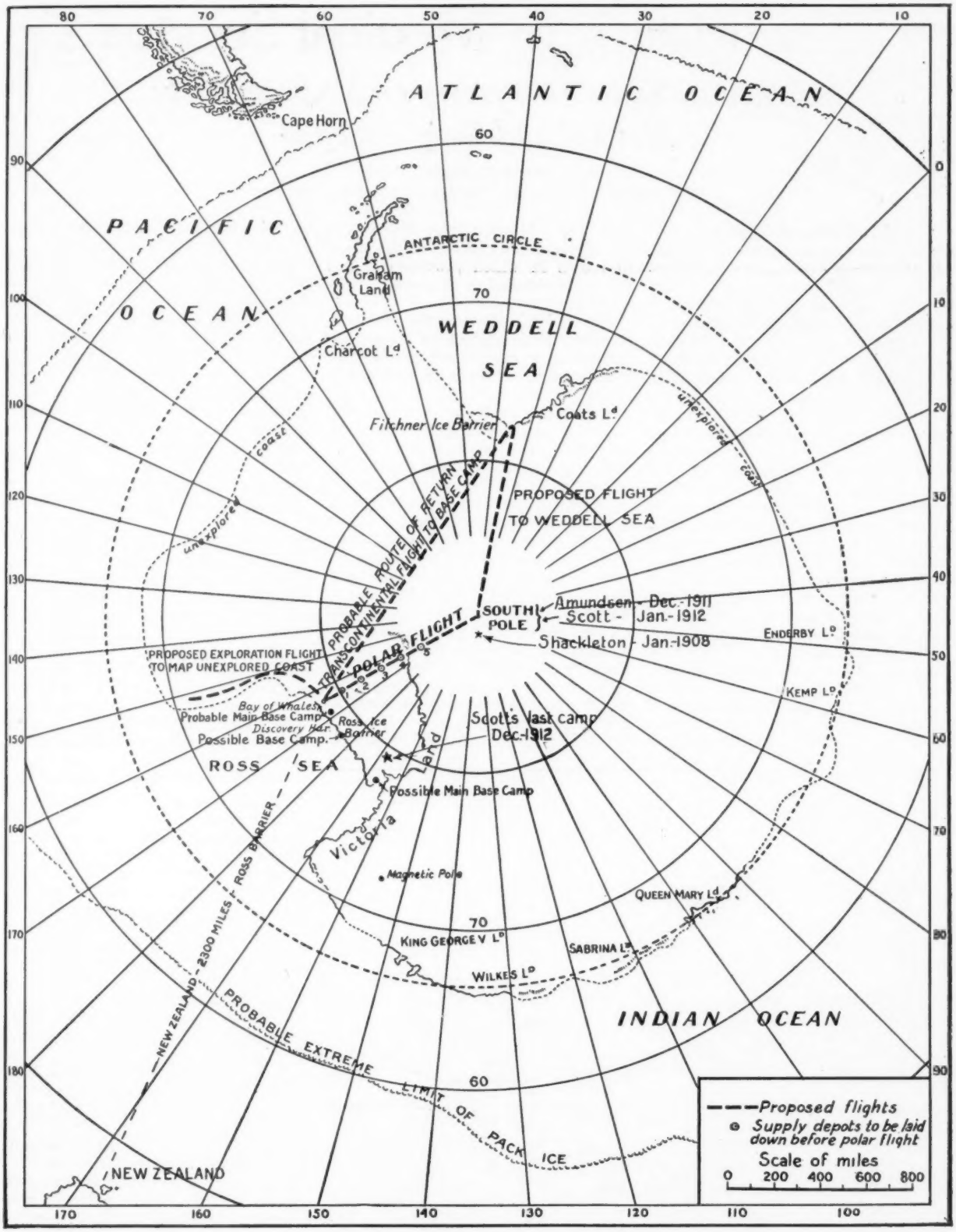
The reinforced concrete tetrahedrons were constructed at a cost of about 112 dollars each, exclusive of the cables, and at the cost of construction of a temporary road into the river bottom, and of a ditch which was necessary to deflect the river away from the construction work. The cost of the protection work, including all expenditures, was a little over seven dollars per lineal foot.

The work of constructing these forms was all done by a day-labor crew with a foreman in charge.



SIXTEEN YEARS OLD AND STILL GOOD

Although somewhat displaced, these old tetrahedrons still successfully combat the floods. Note how the land behind them has been filled in due to the protection afforded by them



Byrd's Proposed Antarctic Route

ALL the world will be reading of and listening to reports of Commander Byrd's antarctic flights. From all available sources of information, we have drawn a map to give the essential facts of previous South Polar exploration, yet the map has been kept as clear as possible so that the reported positions of the Byrd expedition may be plotted in by our readers, as they are received from time to time from his powerful wireless on the *Sampson*.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Ventilation of Schools

THE executive secretary of the New York Commission on Ventilation, Mr. Thomas J. Duffield, has recently made a series of studies to determine the best type of ventilation for schools. An associated investigation dealt with the amount of fresh air required by the average child in school. In one study conducted in Cattaraugus County, New York, 48 rooms in 41 different buildings were investigated. Regular observations were made of the temperature and of the humidity. Schools heated by furnaces were compared with those heated by jacketed stoves and ordinary stoves. In addition to these factors, records were kept of the incidence of coughs and colds among the pupils and of the relationship between such symptoms and the temperature and humidity.

Previous investigations made by the Commission had shown that for purposes of school ventilation, window ventilation was probably as good if not superior to forced ventilation by especially designed ventilating systems. Previous investigations revealed the fact that there was less respiratory disease in rooms with moderate temperatures than in those which were over or underheated.

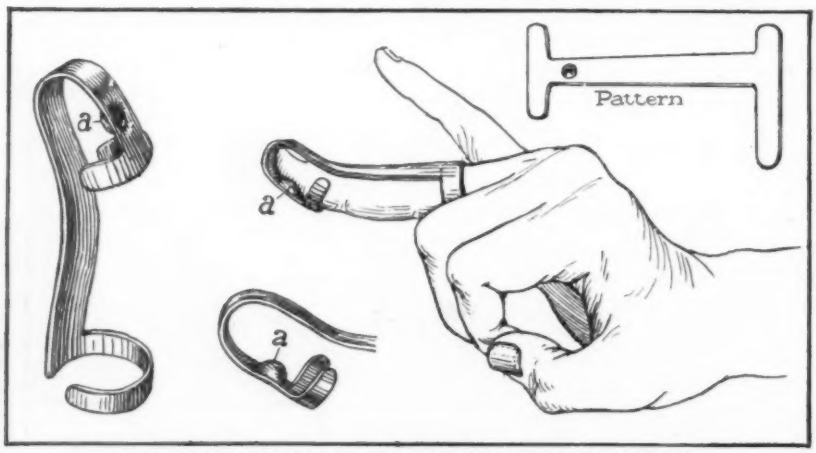
Among other interesting observations it was found that rural schools heated with furnaces and jacketed stoves are more likely to be overheated than the rooms heated with ordinary stoves. Differences in temperature are great between the floors, the ceilings and the centers of the room in rooms in which provision is not made for circulation of the air. Mr. Duffield says:

"In general, the prevalence of respiratory illness shows an inverse relationship to outdoor temperatures; that is, the incidence of respiratory illness is greater during the cold months of the year. In the absence of other factors, however, low temperature itself does not appear to be directly associated with increased respiratory illness.

"During periods of low temperature, deviations from the general trend of the incidence of respiratory illness vary with the fluctuations in precipitation, the maximum effect occurring in the week following that during which an excess of precipitation occurred. As spring approaches and the outdoor temperatures become higher, the effect of precipitation is not nearly so pronounced as during the periods when average outdoor temperatures are below freezing."

The investigations made relative to the amount of fresh air required by the school child indicate that 30 cubic feet of fresh air per minute are required to keep the temperature of a room occupied by fifteen-year old pupils from exceeding 66 degrees Fahrenheit when the outdoor temperature reaches 55 degrees Fahrenheit. First grade pupils require 30 cubic feet of fresh air when the outdoor temperature is 60 degrees Fahrenheit to keep the room temperature from exceeding 66 degrees Fahrenheit.

In this connection Mr. Duffield points out that the mechanical ventilating systems are usually shut down long before outdoor temperatures average 55 to 60. It therefore remains for heating and ventilating engineers to provide first a heating plant that will just compensate for structural heat loss over a wide range of outdoor temperatures, and second a means of introducing quantities of air varying with the average ages of the pupils and the outdoor temperatures in a manner that will not produce draft.



ALUMUMINUM SPLINT FOR HOLDING FINGER JOINTS

Several views are shown. The ball-like prominence a produces hyperextension of the end phalanx

An Improved Splint for Baseball Finger

WITH the coming of summer, innumerable young men who reach with "butter-fingers" for baseballs suffer exceedingly until the jammed up joints straighten out. Dr. Philip Lewin designed a splint for the care of such fingers which is exceedingly simple and which is of great aid in securing a prompt restoration of service. The splint is made of aluminum and is molded to fit the individual case.

The Place of Copper in Nutrition

SECOND only to the fundamental discovery of Steenbock in relation to the irradiation of food is the announcement of the work of Waddell, Elvehjem, Steenbock and Hart to the effect that copper is a substance of the greatest importance in relationship to the building of blood in the human body. Heretofore it has been the general belief that iron is the one mineral substance of primary importance in this connection.

The Wisconsin investigators found that highly purified inorganic salts of iron did not increase the level of red coloring matter in the blood of animals which had been made anemic by being put on certain diets which invariably produce anemia. On the other hand, certain natural foods, such as liver, lettuce and corn are remedial. When these food substances were reduced to ash, these extracts were found to be effective. They therefore determined that some other substances besides iron must be responsible.

An analysis of the ash indicated that a trace of copper invariably present in the ashes of any natural foods, if supplied along with iron salts, elimin-

ated the hazard of anemia when the animals were fed with the diets that have been mentioned. The occurrence of copper in plant and animal tissues has been known for some time. Many investigators find it in the human blood, in an amount approximating 0.0017 milligrams of copper per cubic centimeter.

Here is another metal added to the

BARRACUDA

Sphyraena barracuda *and 11-year old boy, showing relative size of the dangerous fish*

many that are already known to be of great importance in the human body. The sophistication of modern diets has tended to elimination of the mineral salts. Now scientists are beginning to find that these things are of the greatest importance to the human organism, even though the amounts concerned are so infinitesimal as to represent frequently merely a trace.

The Danger From Electric Shock

DURING the year 1926-1927, 64 men were killed by high voltage electric shocks in New York State. It is now recognized that currents of from 100 to 250 volts may be dangerous, and contact with high tension currents up to 100,000 volts that are now employed to transmit electric energy over long distance is realized by everyone to be dangerous.

Electrical burns are treated as are other burns. However, conditions of fibrillation of the heart, stopping of the respiration and sudden death from electric shock are not usually treated correctly. Recent investigations indicate that prompt efforts at resuscitation, including vigorous attempts at artificial respiration, will save many lives.

The paralysis of the breathing apparatus is apparently temporary in many cases; if artificial breathing is kept up long enough, patients may recover who would otherwise die. Experts therefore recommend that movements of the chest should be started as soon as possible and continued even for hours in such cases. The only reason for discontinuance should be unmistakable signs of death.

Botulism in 1927

SOME years ago the country was startled by numerous outbreaks of botulism due to the eating of ripe olives that had been contaminated with this germ. The ripe olive industry supported scientific investigations which have resulted in cleaning up of this danger. The canning industry in general has also paid particular attention to the prevention of botulism and the results have been notably successful.

From 1899 to 1927 there were 150 outbreaks of botulism reported in the United States and Canada, with one outbreak in England and one in Argentine, giving a total of 518 cases with 347 deaths. The mortality was thus 67 percent, which is one of the highest mortalities known in medicine. The disease is rapidly fatal, and for this reason demands so much medical interest. Only five outbreaks occurred in 1927, whereas there would have been 13 if the condition had occurred with the frequency with which it used to occur.

All of the outbreaks in 1927 were due to home-canned foods—in two cases corn, in two cases string beans, and in the remaining cases pears. In four of the cases the food was noticeably spoiled before it was used but the people ate the food anyway. As a result of these five outbreaks, 11 persons became ill and 10 of them died. In one of the outbreaks an entire family was blotted out, the food taken being canned corn which had been made into soup by a child. Four persons ate the soup and all four died. The food had been heated in the making of the soup, but apparently insufficiently to protect against the poisoning.

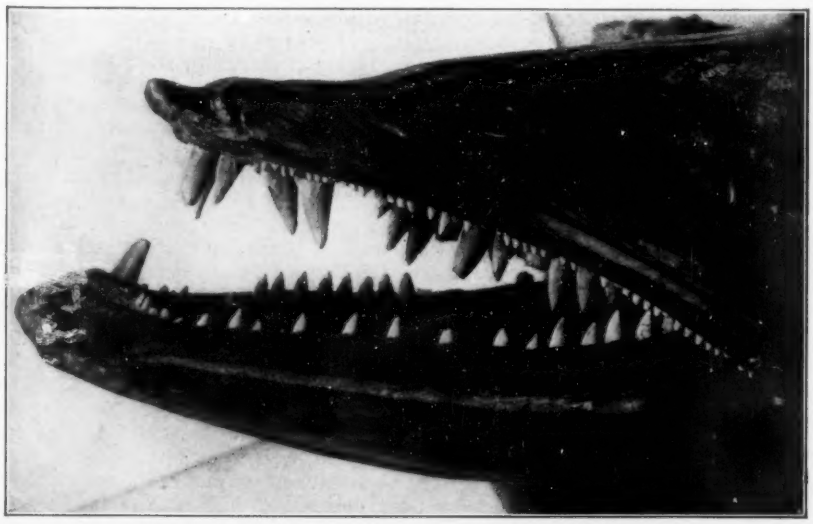
In commercial canning, sterilizing processes have been standardized to such an extent that the industry may be said at this time to be safely conducted for public health.

The Barracuda—A Fish Most Dangerous to Man

THE *Journal of the American Medical Association* called attention recently through an article by Dr. E. W. Gudger of the American Museum of Natural History and C. M. Breder, Jr., of the New York Aquarium, to the fact that the barracuda, a large savage pike-like fish, is probably one of the most dangerous fish that exists in tropical seas. A case is described in which a barracuda attacked a sailor of the United States Navy who was swimming in the ocean near Panama. In that case the sailor was bitten so severely that his limb was almost torn to pieces.

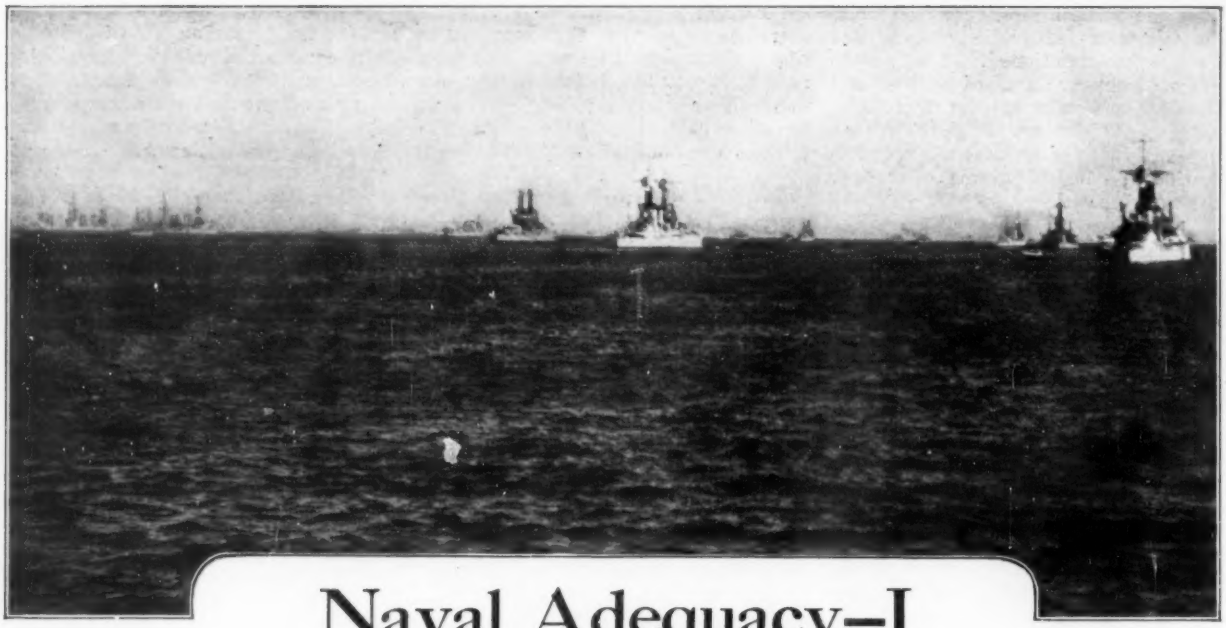
As can be seen by the illustration, the barracuda is almost as large as a twelve year old boy and its mouth is such that any bite is likely to result in severe injury.

The authors report many other instances in which this fish has attacked human beings, sometimes causing death and in other cases the loss of limbs. It is pointed out further that the barracuda is recognized by all of the natives of the Caribbean-Gulf region as more apt to attack man than is the shark. This is due to the fact that its food getting depends on what it sees more than on what it smells. It is attracted by any flashing object, and is likely to strike immediately. It is known, moreover, never to strike more than once. The New York investigators are convinced that the barracuda is the most dangerous to man of all of the fish of the sea.



MOUTH AND JAWS OF A 55-INCH DRIED BARRACUDA

There are two sets of teeth in the upper jaw and only one in the lower



Naval Adequacy—I

Naval Bases Constitute a Primary Element of Naval Strength. The United States Has But a Few, Many of Which Are Woefully Inadequate

By CAPTAIN N. H. GOSS, U. S. N.

The Truth About the Navy

THE accompanying article is the first of a naval series in which we asked Captain Goss to give us the benefit of the broad knowledge of naval questions which he has gained by thorough training, years of experience as a naval officer, and participation in war games of the fleet. Our sole purpose in publishing these is to state authoritatively the case for the navy, to bring order out of chaos, and to show the navy's present handicaps and requirements.

SCIENTIFIC AMERICAN is a strong proponent of naval limitations. We realize, however, the necessity of maintaining our navy so that it provides adequate military protection based upon our specific naval problems which, assuredly, are different from those of other powers. These problems retain their relative proportions regardless of limitations. In his articles, Captain Goss discusses the many varied elements embodied in the broad subject of naval strength and shows their relation to each other by the same method naval experts employ to determine what constitutes an adequate navy.

No war hysteria should be included in a discussion of this nature. Great Britain and Japan are mentioned in this series of articles only because these two nations happen to be comparable, in naval power, to the United States. Any plea for adequate naval strength must, therefore, be predicated upon a study of heir strength as well as upon consideration of our own absolute needs.

—The Editor.

SEA-POWER is an inclusive term since so many elements constitute naval strength. First there are the "positions" of which Napoleon used to talk; and these positions, upon which ships may rely for fuel, shelter, and repairs, are, in many cases, even more important than military positions on land; for ships have to go somewhere and can stay at sea for a limited time only. Hence their usefulness and the areas in which they are able to operate depend almost entirely upon these strategic developed positions which are called naval bases.

Ships are naturally a cardinal element of naval strength and in these modern times the word is an inclusive term as well, since it encompasses not only combatant men-of-war but also plane-carriers, aircraft, tenders, repair vessels, and finally, merchant ships for the transportation of supplies.

THE third cardinal division of naval strength is personnel, for, at sea especially, it is still the trained man behind the gun and in the engine room that counts; efficient naval personnel cannot be improvised overnight no matter how great may be the general resources in man power of a nation.

Trained personnel is an especially important factor of sea power also, because to a maritime country like ours, without powerful continental neighbors, the navy is the first line of defense, the first to meet the shock of conflict, the outer bulwark behind which the country has to mobilize and organize in time of stress; hence to be of value it must always be ready and efficiently maintained in time of peace.

It is only natural that one hears more of the discussion about ships or aircraft or some of the more easily recognizable elements of naval strength than one does of the more prosaic fac-

The illustration at the top of this page shows the fleet at Lahaina Roads, the only fleet anchorage in Hawaii. Unsheltered from the west, this open roadstead lacks harbor facilities.

tors of naval bases and personnel, but these more silent partners are not less important. We hear a good deal of the general term, *adequate navy*. It has been included in party platforms for years, but we do not hear so much of what *constitutes* an adequate navy. If we look into it, however, the term is not so hard to define, for a navy is adequate when it is equal to its allotted tasks and able to support and defend the country's policies.

The tasks that fall to the navy's lot depend naturally, to some extent, on the strength of the other principal naval powers, but, first of all, they depend upon geography; the location of the country and the length of its coast lines; the location of its harbors and their shelter, commercial, and repair facilities; whether it fronts on one or more oceans; the location of its possessions and whether they are self-supporting; whether the country is dependent on imports of essential commodities and, if so, the location of its trade routes; the communications between the different coasts of the home-land and its possessions; the quality of the harbors either developed or suitable for development into naval bases; and the distances between important ports in the home land, between its coasts, and to its important possessions.

This leads naturally into a discussion of the first primary element of sea power, viz., naval bases. It is not the purpose in this discussion to go deeply into the question of home-land defense of the principal naval powers, since it is to be conceded by a non-aggressive country such as ours, that each of these powers should be supreme in her own waters. It is particularly unnecessary to discuss this in the case of Great Britain which is but a small island country possessing many good harbors close together, with very extensive and quite ample repair, docking, and shelter facilities. The same is true of Japan, although her location so much nearer to our own possessions in the Far East, and her encircling position in front of our markets in China, are a matter of concern to us. Suffice it for the moment, however, to say that Japan, too, has these facilities in ample measure.

SINCE it so happens that the United States, the third of the principal naval powers under discussion, is the only one that is a continental nation fronting on two oceans, distant from each other many thousands of miles by sea, the naval defense of this country is inherently a more complicated and difficult problem. While the British or Japanese home fleet could, in a matter of hours, steam from port to port and encircle either the British or Japanese islands, it would take a matter of days for such a fleet to cover even one of our two coasts. We see, then, how geography is inherently such an important factor in naval strength and how, since a fleet cannot be in two places at once, it determines in advance the fact that considerable force is required to constitute an adequate navy for the United States.

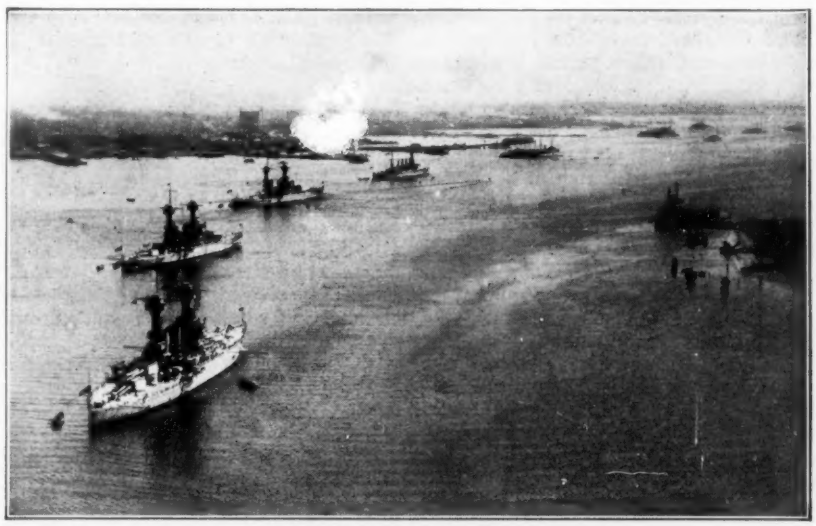
Each of the three powers under discussion has extensive possessions outside its home land area. Of these, the Japanese are by far the more compact. Korea lies only a few miles across the Sea of Japan; Port Arthur and the ports of Manchuria, where she at present exercises a predominant interest, are just beyond. Her main group of islands encircle the principal ports of China with whom she has, to say the least, trade connections of extreme importance. The mandate islands composing the Marshall and Caroline groups are relatively close at hand, the farther group being not more distant than San Francisco is from the Hawaiian Islands.

GREAT BRITAIN, as every schoolboy knows, has possessions covering the seven seas. In this discussion, however, we are not concerned with those in the European zone, in Africa, or in the south Pacific, but only with those that lie off our own coasts, along the approaches to the Panama Canal, across the trade routes to South America, or near our present possessions in the Far East. These will be referenced in some detail, since they contain harbors that are of present or possible use for ships, some being developed naval bases, some with commercial facilities, many that at least offer shelter, and some that are readily capable of development into advanced naval bases.

All these points affect naval strength and have a bearing on what constitutes an adequate navy. Beginning near our own coasts, the British have Bermuda a few hundred miles distant—say a few hours by air. Bermuda has a small naval station; a naval drydock capable of handling destroyers, submarines, and light craft; extensive sheltered anchorage space; some degree of fortified protection; and is, on the whole, admirably adapted for use as an advanced naval and air base.

A little farther down towards the Caribbean and directly on our route to Panama, Great Britain owns the Bahamas with their various sheltered anchorages. Inside the Caribbean, still on the route to Panama, she possesses Jamaica which has many resources of supply, considerable harbor developments, and is partially defended. Along the eastern fringe of the Caribbean, Great Britain owns most of the Leeward and Windward Islands which lie along the trade route to South America. Some little commercial facilities exist in various of these islands; and under the lee of St. Kitts and Nevis is the fleet anchorage alternately used by the French and British fleets during our colonial and Revolutionary War period.

TO complete the chain encircling the eastern Caribbean, the British have Trinidad with a sheltered anchorage sufficient for any navy. On the north coast of South America lies British Guiana and up the Central American coast from Panama we soon come to British Honduras on the flank of the route into the Gulf of Mexico. None of these latter possessions are fortified in a modern sense but all have some shelter, many of them have some commercial harbor facilities, many offer some supplies of various natures, and



THE HARBOR AT SAN DIEGO

This is the principal destroyer, submarine, and air base on the west coast. The harbor is small and the channel too shallow for our new aircraft carriers. The air base dock is shown on right

BEAUTIFUL HILO HARBOR, HAWAII

Although this is our principal port in Hawaii, it is but a small harbor open to the sea. It will be seen that great crowding is necessary in order to anchor only a small part of the fleet

all have potential value when in the possession of a foreign power.

IN the Pacific we shall, as noted heretofore, concern ourselves only with foreign possessions that lie along our lines of communication with our present possessions in the Far East. Of the three routes, the northern one, by way of the Aleutian Islands, is effectively barred for reasons that will be discussed later with reference to the treaties emanating from the Washington Conference. The southern route, by way of Samoa, although the longest, has some potential value since it is the most direct route from Panama. The British now have the former German possessions in Samoa itself; the Fiji Islands about 650 miles away; anchorages of some consequence in the New Hebrides and Solomon Islands; and an extensive fleet anchorage in the Admiralty Islands just off the coast of New Guinea. Near the Philippines, only 600-odd miles across the China Sea from Manila, lies Hong Kong, a British possession of many years standing, with the best dock, harbor, and base facilities on the China coast. Furthermore, the British are developing at Singapore, less that 1400 miles from Manila and less than 1000 miles from the western portion of the Philippine group, a great naval base of first magnitude destined to be their main position in the Orient. It will be an ample, fortified base capable of docking their largest vessels.

To complete the picture of the inquiry into the bearing of naval bases on sea-power, we will now consider our own possessions. In the strategic areas which encompass the defensive areas off our own southern coasts—our vital communication lines in defense of, and through, the Panama Canal, and with South America from which we must import essential commodities such as sugar, coffee, nitrates and manganese—we have a small naval station at Guantanamo on the south coast of Cuba, 60 miles westward from Windward Passage. This is unfortified, has very limited fuel and supply facilities, no repair facilities of importance, no drydock, and is of too limited extent to shelter the major portion of the fleet.

We have close political and trade relations with Cuba, Haiti, San Domingo and the Central American countries north of the Panama Canal, but on none of these could we rely, in case of war, for anything beyond benevolent neutrality. The canal itself is strongly fortified as an outpost but its continued possession by us is dependent on command of the sea. Its possession may be considered of paramount importance, and it is certain that its defense could not be neglected in determining the naval strength of the United States.

WHILE we have ample docking and repair facilities at our bases on the Atlantic coast, we are not so fortunate on the Pacific. There is one large dock and considerable repair facilities at Balboa, in the Canal Zone. At San Diego, where our destroyers, submarines and aircraft base, we have our most extensive air base, although the channel and wharfage does not permit our new giant aircraft carriers to enter port. Destroyers there base almost entirely on their tenders, and the improvised repair facilities ashore are not even sufficient to care efficiently for the large number of destroyers laid up at this port of commission. Submarines basing there are dependent entirely upon their tenders. The supply facilities are adequate for peace time but not for war. This port is blessed by excellent climatic and weather conditions, but its harbor is very limited, is unfortified in a modern sense, and is directly open to gun-fire from vessels at sea.

At San Pedro, where our battle fleet normally bases, there is nothing except an open roadstead and an extremely limited space behind a small breakwater. At San Francisco, one of the best harbors in the world, which is admirably adapted by geographic location, commercial connections, port, supply, labor, market, and other commercial facilities, to be the great natural base on the Pacific coast, there is only one commercial dock down the bay at Hunter's Point that our large vessels can possibly use. True, we have extensive dock and repair facilities 30 miles up the bay at Mare Island, but the channel there is so narrow and shallow that it is very inconvenient even for our cruisers.

Our other base on the west coast is at Bremerton, about 18 miles across Puget Sound from Seattle, where we have two docks capable of handling our largest vessels, and other extensive base facilities and equipment. The use of this base, however, is handicapped by extensive fogs and treacherous currents in Puget Sound, and the base is inadequate to handle properly all the heavy ships of our battle fleet even in peace time.

PEARL Harbor in Hawaii, a few miles from Honolulu on the Island of Oahu, is our advance base in the Pacific. There we have one dock of major size and a slip for hauling out submarines and small craft, extensive fueling equipment, but limited repair facilities. At present, Pearl Harbor is very limited in berthing facilities. Unfortunately, also, the total water area of this natural harbor, even if dredged, is quite too limited to accommodate a fleet. As everyone knows, the harbor at Honolulu is extremely small, and the open roadstead off the harbor is uncomfortable in peace time and would be impractical in war. The only anchorage in the Hawaiian group that could contain the fleet is what is known as "Lahaina Roads," off the Island of Maui. This position is somewhat sheltered to the north, south, and east, but open to the west and incapable of fixed defense except by mines.

The above has been discussed at some length, since this present weakness in base facilities on our Pacific coast itself has an important bearing upon the general subject of other bases in the Pacific. Since ships that are either undergoing repairs or laid up awaiting repairs, temporarily have no military value, they have to be deducted from the strength of the fleet at that particular time. In actual practice, it is seldom possible to have all vessels away from the yards with

the fleet at once, so that the more quickly ships can be refueled, repaired, or overhauled, the less the fleet at sea will be handicapped.

It has to be noted here that at the Washington Conference the Japanese refused to consider any of our suggestions for limitation of fighting ships unless we agreed in advance to abstain from amplifying the base facilities we had in our own oriental possessions, and unless we also agreed not to establish any new bases or fortifications in the Philippines, in Guam, in Samoa, or even in the Aleutian Islands. Students of Pacific problems quickly learn that great distances are involved in this area.

It is nearly as far from our west coast to Honolulu as it is from our Maine coast to Europe. Despite the great advantage of the Panama Canal, it is more than 3000 miles from the Panama Canal to San Francisco, a distance greater than from New York to Europe. It is even farther than this—over 3300 miles—from Hawaii to Guam, and Guam is only a little more than two thirds of the way to Manila. The route directly across from Panama by way of Samoa is naturally still farther. The northern route by way of the Aleutian Islands is much shorter, but no harbor facilities or modern aids to navigation exist in the natural harbors of the Aleutian Islands, and this route leads directly by the main Japanese Islands as well. So at present the only feasible route to the Philippines is by way of Hawaii.

Examining this route we quickly see the strategic and great potential value of the Island of Guam. This island is actually an ideal possession for an advance base since it is compact, about 40 miles long, with high land and rugged shores, and is surrounded by deep water not easily mined. It has a small natural harbor capable of extensive development.

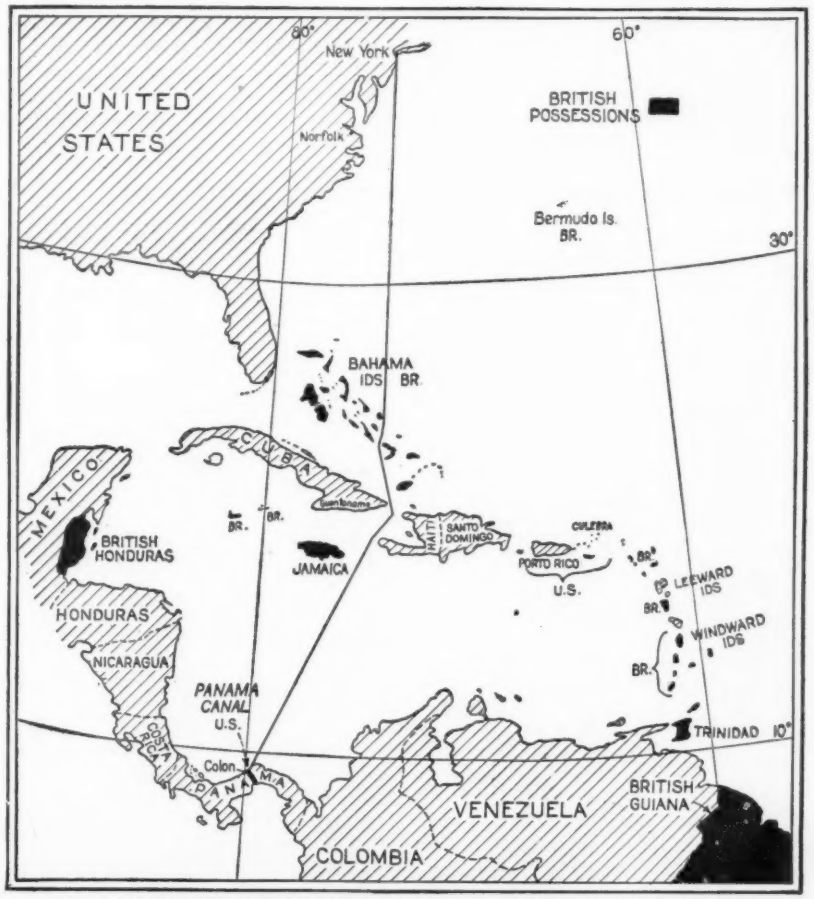
NUMEROUS and abundant harbors abound in the Philippine group. Manila Bay itself could easily shelter all the vessels in the world. Previous to the World War, the entrance to this bay, Corregidor Island, and one or two smaller islands, were extensively fortified. It was never expected, however, that these fortifications could withstand siege operations, and modern aircraft development has still further reduced their resisting power. At Cavite, a few miles across from Manila, is an old naval station, very little advanced since the day of Spanish rule, located on shallow water and capable, at most, of handling only destroyers and submarines. Besides the small marine railway at Cavite and a small commercial one nearby, we have the drydock *Dewey*, also in the Philippines. This dock, capable of handling nothing larger than cruisers, is at Olongapo on Subic Bay, 40 miles up the coast from Corregidor. Deep water abounds there but the position has no defenses, and all supplies and material must be brought by sea from Manila.

WE now begin to see what an effect the lack of bases, refueling and repair facilities have on the naval problem, especially where they are coupled with the vast distances that obtain in the Pacific, and again, something of what is required to constitute an adequate navy of ships. Not only does it take long periods of time and much fuel to go from port to port in this area but, due to lack of defended bases with ample resources from which to operate, lines of communication requiring many additional escort vessels, particularly of the cruiser and destroyer types, must be maintained.

Having determined somewhat the meaning of the term "adequate," we may also obtain an idea of what "comparative" naval strength means in this area, for, as we see by the map, our possessions in the Far East lie much closer to Japan, to outlying Japanese Islands, and to present British bases and sheltered harbors, than they do to our nearest base in Hawaii, much less to the more adequate resources of our own coast.

It is common among naval strategists to refer to Guam as the "key to the western Pacific," as indeed it would be were it developed and fortified; but at present it is a source of weakness rather than of strength. Not only are the main Japanese islands less than 1500 miles from Manila, but Japan already had, at the time the status quo was established by the Washington treaties, numerous advanced bases of considerable value even nearer. She had an advanced base in the Pescadores Islands in the Formosa Channel, only 600 miles from Manila. This was fortified and had considerable area, supplies, fuel, and overhaul facilities for destroyers and small craft. She had advanced bases of some force at the anchorages at Amami and Okinawa, in the Loo Choo group northeast from Luzon and less than 1000 miles from Manila. Eight hundred and thirty miles north of Guam, and only 500-odd miles off her own coast, she had a valuable advanced base in the Bonin Islands.

Under the mandate provisions Japan controls the former German cable sta-



OUR LINE OF COMMUNICATION THROUGH THE PANAMA CANAL

There are many good harbors in the encircling curve of British possessions within easy striking distance of the Panama Canal and our supply and communication route to the Pacific

tion at Yap, and the Pelew Islands between Guam and the Southern Philippines; in the Caroline group, less than 600 miles away, she controls a sheltered anchorage at the atoll of Truk, capable of sheltering the fleets of the world. In the Marshall Islands, on the southern flank of the route to Guam, and on the way from Samoa to Guam or the Philippines, she controls extensive anchorages at Eniwetok, Rongelob Wotje, Jaluit, and Ponape.

HONG KONG, the British base in China already referred to, is only about 600 miles away and the new British base at Singapore is only some 1300 miles from Manila. British anchorages and harbors in the Fijis, and the Admiralty Islands along the route from Samoa to the Philippines, have already been mentioned. It may also be stated in passing that the only harbors near the route from the Panama Canal to Samoa are in the Marquesas, Tuamotu, and Society Islands, owned by the French.

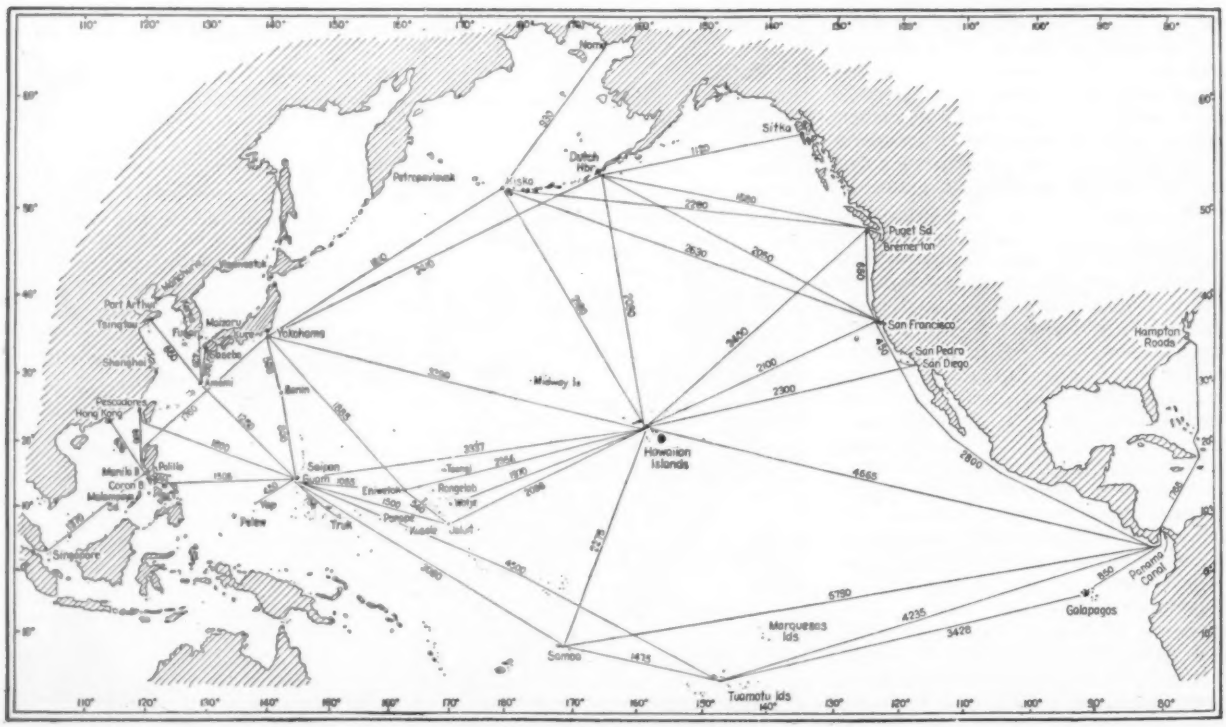
From this brief survey it can be seen that a force adequate to cover this area for us must be considerable because of the long distances involved, and our lack of secure bases from which to refuel and operate; also that like numbers of ships would give not only the Japanese but the British as well, much greater comparative strength in this area than it would give us. This is especially true in view of the fact that the United States is prohibited by treaty from establishing any secure base facilities in the Aleutian Islands or in Guam and, furthermore, is even prohibited from fortifying against siege operations any positions in the Philippines themselves.

As an example of how adequate numbers multiply in comparison, Japanese vessels could steam at moderate cruiser or destroyer speed—let us say 20 knots—from their position in the Bonin Islands to Guam in 42 hours, or from their secure base in the Pescadores Islands to Manila in 30 hours. British vessels could cross from Hong Kong to Manila in the same time, or a British fleet could steam from Singapore in less than three days. For us, the distance from our nearest secure base at Pearl Harbor is so great that no vessels could cover it at high speed. Destroyers would have to be refueled en route unless they steam at their most economical speed of about 10 knots, which is quite too slow for military purposes. This indicates the great value of naval bases. Possession of these greatly increases the relative strength of a fleet; lack of them can be overcome, if at all, only by a numerically larger fleet.

Raiding Japanese or British forces could strike at our positions in Guam or the Philippines, return home, refuel, and be out again long before any help could come from our position in Hawaii. This is the same thing as increasing in relative numbers the British and Japanese fleets. The same is true were our fleet actually in the Philippines. It would have no secure base in which to lie or from which to operate and would have to defend and maintain itself; and to do this, a large portion of its effective strength would have to be employed defensively in attempting to maintain its own communications. This means that equal numbers of ships leaves the balance of power in the Philippines in the hands of either the Japanese or the British.

COMING nearer home it should be remembered that the Panama Canal is dependent upon our undisputed control of the sea in that area. Whatever force is detached to guard it or to secure our communications with it, weakens the fleet to that extent. The present British positions, previously referred to, increase the numbers that would have to be detailed for this purpose and reduce correspondingly the relative strength of our fleet.

It is the task of the navy to defend our overseas possessions and protect our essential trade routes. It is adequate only when it is strong enough to do this, or strong enough to make it too risky for others to interfere with our policies. By this study of geography we see what a large bearing the possession by others of naval bases and suitable harbors in our important areas, and our lack of these same facilities, has on the subject of naval strength insofar as it particularly concerns the United States.



STRATEGIC MAP OF THE PACIFIC

Slightly off scale due to flattening, this map shows the mileage between important Pacific ports. The weakness of the United States in this area can be noted by following on the map the facts brought out by the author. Further development of bases is prohibited by treaty

Painted under the direction of Henry Fairfield Osborn, by Charles R. Knight for the Hall of the Age of Man. Reproduced by permission of the American Museum of Natural History. Copyrighted.

A SCIENTIFIC RESTORATION OF THE GREAT TAR-POOL AT RANCHO-LA-BREA, NEAR LOS ANGELES

The giant sloth of South American origin is about to become mired in the tar. The saber-toothed tiger will follow, and next to be trapped will be the great extinct condor. In the background is the huge imperial elephant or mammoth, frequently too intelligent to be trapped

Extinct Animals of California

Fossil Remains of Creatures Which Lived Thousands of Years Ago Have Been Exhumed in California

By CHARLES H. STERNBERG, A.M.

Member, Paleontological Society of America; Society of American Vertebrate Paleontologists

OWING to the kindness of Dr. G. Dallus Hanna, Curator of Paleontology of the California Academy of Sciences, I was directed to the deposit of extinct mammals, birds and reptiles at McKittrick, 35 miles west of Bakersfield, California, in the oil fields. I received authority from Mr. Hall, manager of the Midway Petroleum Company, on whose land the deposit lay, to make the necessary excavations. He also allowed me to use a house on the lease, half of which I turned into a laboratory while I lived in the other half with my wife.

THE University of California had already done work here, taking out a mastodon skull and many other bones. I began work in 1925 and exhausted the quarry the last of October, 1927, exploring carefully the area on the northwest side of the highway. Here I was so fortunate as to discover a great drift of bones 50 by 60 feet in area, and about two feet thick. These bones were filled with asphaltum, from a flow of quite recent time.

When I collected the specimens I took them to my work-shop and washed the bones in distillate to remove the tar. When they were dry I brushed them clean, then soaked them in dilute shellac to prevent their falling to pieces. I then mended the broken ones with a cement made of gum arabic and plaster of Paris. I was thus enabled to send the prepared material to Dr. Chester Stock of the California Institute, at Pasadena, for scientific study.

When I went to the locality, I was led to believe that it resembled the one at the Rancho-la-Brea tar-pools—that great trap where, during Pleistocene and post-Glacial times, many animals had been caught. It has been in operation for many thousands of years, and hundreds of saber-toothed tigers, dirus wolves, horses and many other species have been caught in the tar, from which there was no escape.

Courtesy of *Pictorial California*

FOSSIL MAMMOTHS—LA-BREA

Bones of the imperial mammoth, largest of all elephants, which was trapped in the tar

All the skeletons found at Rancho-la-Brea were disarticulated, the bones indiscriminately mixed together. In my quarry, however, I found that the animals had been carried in by water, and thus many articulated skeletons of carnivores and herbivores lay mixed together, besides countless thousands of scattered bones of birds and mammals.

I FOUND a Great Bison, much larger than the recent buffalo. The horn cores measured 44 inches from tip to tip. It was 11 feet from the end of the chin to the base of the tail.

The hump was 18 inches high. The horn cores were at right angles to the skull, with tips turned back. The head lay under the hump, showing that the animal was carried to his burial by water. After death he had sunk to the bottom of the river. Then the gases filled the body and floated him. He was finally swept into an eddy and there whirled around until vultures had liberated the gas, when he sank to the bottom.

I found horses and camels, llamas, antelope, bison and saber-toothed tigers, wolves, lions and bears, lying together—the first time after an experience of 60 years in the fossil fields, that I have found carnivores and herbivores mingled together in death.

The same series of events I have mentioned above in connection with the Great Bison must have been the fate of all the animals whose articulated skeletons I found here, of which about 20 are in good enough condition to be mounted. There were also countless scattered bones of mammals and birds mingled with the others, showing that a great flood had brought down the drowned animals and the others whose bones lined the shore of the river. All were picked up and carried to this great cemetery of God's buried dead.

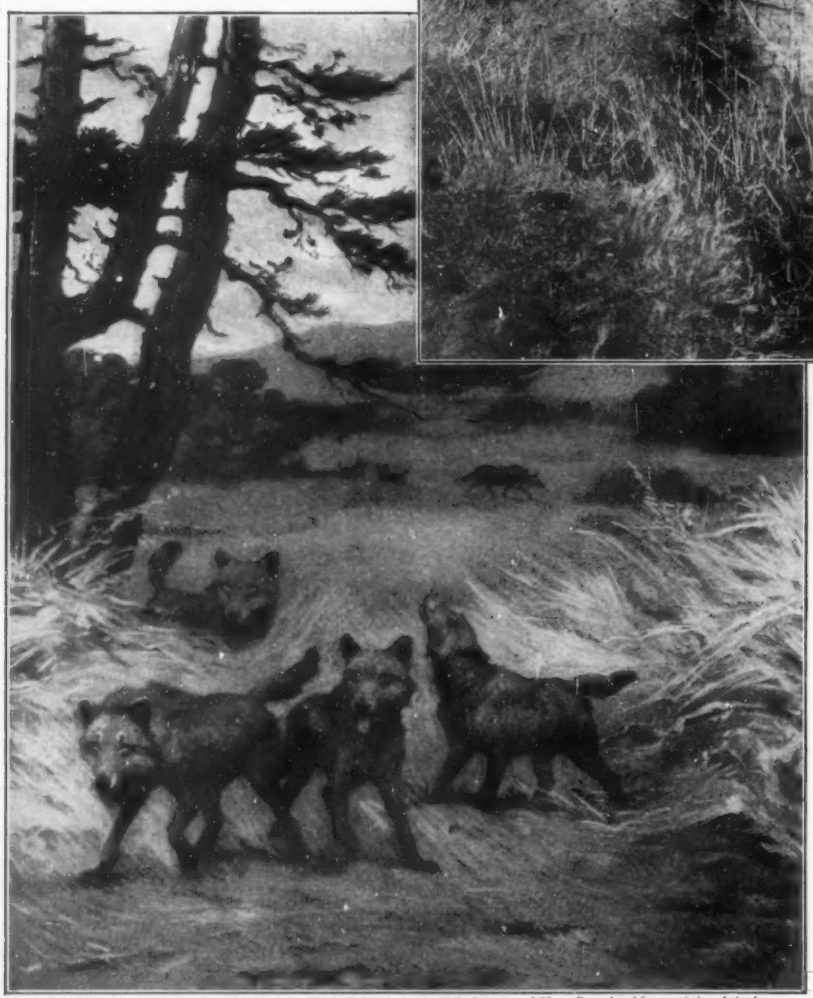
I FOUND the skeleton of a mastodon, nearly complete, with the exception of the skull; also 12 skulls of the extinct horse (the western horse). The skulls measured from 25 to 30 inches in length. I found young and old horses, one showing the permanent teeth gradually pushing out the worn milk dentition.

Here too, I secured a fine skeleton of a large camel, as large as the Asian variety. The camels and horses originated in North America and became extinct during the Pleistocene. I found two llama skulls with enough of their skeletons to make open mounts. They are closely related to the South American llama. Then, too, I found a new species of a musk ox and a couple of antelope exactly like our northern prong-horn.

Courtesy of *Pictorial California*

TAR AT LA-BREA

Only in times of severe drought did the animals risk the deceptive surface water over the tar



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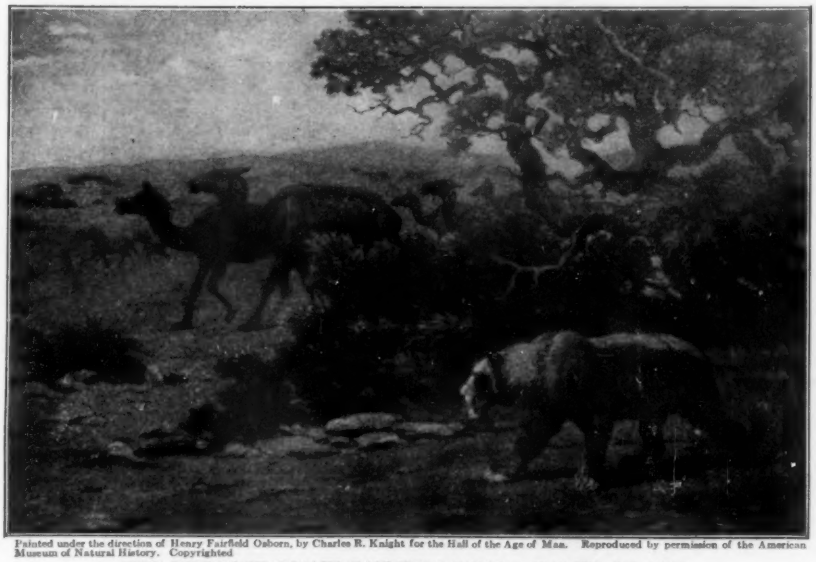
DIRUS WOLVES AND WESTERN HORSES

The western fossil horse differed from modern horses. Horses later became extinct in the New World, although their whole evolution had taken place there. The Spaniards re-introduced them

I SECURED only six dirus wolves. These extinct wolves are very abundant in the Rancho-la-Brea tar-pools at Hollywood. They were much larger than the grey or timber wolf of which later species I secured 10 skulls and several skeletons.

I also discovered 16 coyotes showing a much closer approach to recent times than those of the Rancho-la-Brea tar-pools at Hollywood. I procured a small and a large lion. The skull of the latter was 17 inches long and 11 inches high. Then I discovered a brown bear skull and skeleton, and a short-nosed bear which is now extinct.



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THE EXTINCT GIANT CAT STALKING A CAMEL-LLAMA

The giant cat, proportioned like a lion, far exceeded in size the living lions. The camel shown was closely related to the South American llama. The camels, like the horses, evolved in America

I found only one saber-toothed tiger, although they were very abundant in the Rancho-la-Brea tar-pools. I found also badgers, a skunk, fox, jack rabbits, rats and mice. There were countless birds, not many perfect skulls, but thousands of scattered bones. Among them was the great extinct vulture (larger than the California condor of today), many waders and swimmers, land birds and so forth. Dr. L. H. Miller of the University of California at Los Angeles, after looking over a very small part of my collection, identified 100 species.

WE can imagine a wonderful fauna during the time these animals lived. Quantities of sticks and branches of trees are associated with the bones, as well as beetles, a few land shells, four turtles and other material. I got only one specimen of a sloth. They were dying out. Numbers were found at the Rancho-la-Brea tar-pits.

The material in which these animals were buried was very fine clay. Below the tar that extended downward only about two feet the clay was filled with water, impervious to asphaltum. Scattered through it, however, were many pockets, usually round, that passed through the bone-drift above and extended down through the clay—in one place 17 feet below the highway. These pockets were from an inch to two feet in diameter, but three which were on the margins of the bone drift were several feet in diameter, wide at the top and narrow at the bottom. In one of these I found over 60 jack-rabbit skeletons, countless jumping rats, mice, and many birds.

I felt confident from the first that these pockets and their contents were of recent time, because they were filled with sand like that on the surface, through which asphaltum from the mass on top had melted in hot weather and run down as far as they went, while there was none in the clay on either side. In one case I found a skull of a horse with nose down, as if it had fallen into a hole from the drift above.

Dr. Chester Stock, vertebrate paleontologist of the California Institute of Technology at Pasadena, in whose employ I was, requested me to make further excavations at the University Quarry, across the highway. Here I discovered a pocket similar to the one in my quarry, and some 10 feet below the surface. It was full of sand, jack rabbits, rats, mice, many bird bones, roots of plants, sticks, and beetles, all thoroughly saturated with asphaltum from above. Here I found the arch wing bones of a bird, held together with cartilage.

DR. CHANEY, Research Associate in Paleobotany of the Carnegie Institution of Washington, found the roots in these pockets to belong to plants of post-Glacial geological age and this establishes that the pockets belong to the same epoch. This shows how easily one may be deceived; the ordinary observer would have thought that all the animals and birds found belonged to the Pleistocene or Glacial Epoch, as the horse, camel and other Pleistocene animals were abundant here. The extinct animals gradually disappeared and recent ones took their places.

As we do not know when Pleistocene time ends and post-Glacial time begins, this great collection will help solve the problem. The great scientific value to the world is the preservation of some 20 articulated skeletons.

¶ *What sort of a world does a dog live in? Does a dog hear, see and react like a man? Scientists have learned that a dog's psychological world is not the same as man's. In an early issue a noted animal psychologist will elucidate.*

Courtesy *Pictorial California*

AT WORK IN THE LA-BREA PITS

McKittrick is 120 miles northwest of La-Brea, but the two localities have much in common; La-Brea is early Pleistocene, McKittrick more recent. Most of the fauna was the same in both places

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WHERE BEAUTIFUL ARCHITECTURE REIGNS SUPREME

In the "Golden Triangle," where once squalor and poverty held sway, the new Art Center of Philadelphia now stands. Here will be assembled the treasures of the Pennsylvania Museum, and famous paintings from various private collections

When Art Replaces Ugliness

A Section of the Slums of Philadelphia Has Been Eliminated, and in Its Place Now Stands an Architecturally Beautiful Art Center

WITH an art history dating from the time of Benjamin West (the first American artist to win recognition abroad) and known throughout the world for its private collections, Philadelphia is contemplating an Art Center in which the chief element will be a museum now rapidly nearing completion. This will assure the assembling under one roof of the treasures of the Pennsylvania Museum, and the famous paintings of various private collections already acquired or promised as final disposal.

The new Museum looks down an avenue that will rival the Champs Elysées and surveys an area from which all unsightly buildings are to be swept to make way for gardens and for new structures of beautiful design to house Philadelphia's venerable institutions of culture.

The Parkway, its main approach, is another of the world's great boulevards in the making. The Museum and the Free Library are but two of the splendid structures which will line this avenue. Sites have been reserved for the future homes of the American Philosophical Society, the Rodin Museum, the Franklin Institute, and, in front of the Museum, for the Pennsylvania Academy of the Fine Arts and the Museum's School of Industrial Art. Of this great cultural and civic center the new Museum will be the chief architectural feature.

GUARDED for all time against the city's encroachment by the Park and the Schuylkill River on three sides and the Parkway stretching out before it, the new building, like the temples of old, has been built for the ages. Minnesota dolomite, a most enduring marble, is the material of its massive walls. The stone, a flushed yellow, recalls the beauty of the Parthenon, as do many of the other architectural features.

Built as a unit, it thus becomes the largest structure of its kind and its unique arrangement is designed for the most effective display of present treasures and future acquisitions.

Objects of art, placed in authentic rooms of the period that produced them, will live in the atmosphere of their own time and place, as they cannot live in miscellaneous collections.

Groups of period rooms arranged in historic and geographic order will invite the visitor to walk through the pageant of historic beauty of all times and lands. The entire principal exhibition floor will be given over to the realization of this ideal. The main galleries for each nation and age will be flanked by an unbroken series of 37 period rooms and backgrounds. Here the visitor can live again through the

ages of Oriental, European, and American art.

Authentic period rooms from the fast vanishing mansions and fine old homes of America and England have been provided by the Pennsylvania Museum and its friends. Furniture and other objects of decorative art to perfect the historical settings are also available from the collections which the Museum has built up during the last 50 years.

But interesting as are the collections, from the layman's standpoint it must be said that the architectural effects are the most unusual, for these fittingly include the long disused principles of pure Grecian architecture which have made the Parthenon the envy of all builders.

There is not a straight line in this 11,000,000 dollar structure. Columns are slightly off the vertical. Walls are imperceptibly bulged or bent. What seem to be unvarying lines are slight curves. There are 40 columns in the new Art Museum, and each group leans toward the center as well as toward the building, the variation from the perpendicular being about four inches in the 60-foot height of the column. These rows of columns are so finely pitched that a series of straight lines drawn through the center of each column would meet in the air about two and one half miles above the portico. A 125-foot wall in the Philadelphia structure varies five inches at the point of greatest curvature and even the terra-cotta roof is built slightly concave in order to register a perfectly straight line to the eye.

THE architectural refinements are based upon the work of the late Professor W. H. Goodyear of the Brooklyn Institute, and a scale model was built in accordance with his markings on the blue prints.

As each of the 40 columns was constructed of from 16 to 20 drums and they were not made up of precisely similar sections, exacting accuracy was necessary here, as in the walls, in order to avoid re-cutting and resetting. What Professor Goodyear worked into the design were changes similar to those made by Greek architects to satisfy the eye's demand for apparent and not actual straight lines. The line of a building over a row of columns appears to sag when made level. This has been corrected by a rising curve. A column that is perfectly cylindrical appears to be pinched at a place about half its height. To overcome this apparent thinning, a faint bow is given at a place about one third up.

The Greeks had noticed that columns placed at angles against a background of sky appeared smaller than others in the portico. To correct this error of vision there was a slight increase of diameter of columns at the angle of the building. Still another optical illusion occurred in the columns. A colonnade that was perfectly vertical seemed to spread. As a correction the Greeks inclined the axes of the columns ever so slightly toward the center of the portico.

The first use of such architectural corrections is found in the atrium of the Temple Medinet Habou in Luxor; an edifice built about 1500 B.C. This knowledge was carried over to Greece and had its finest development in the Athenian Parthenon which was built about 450 B.C.

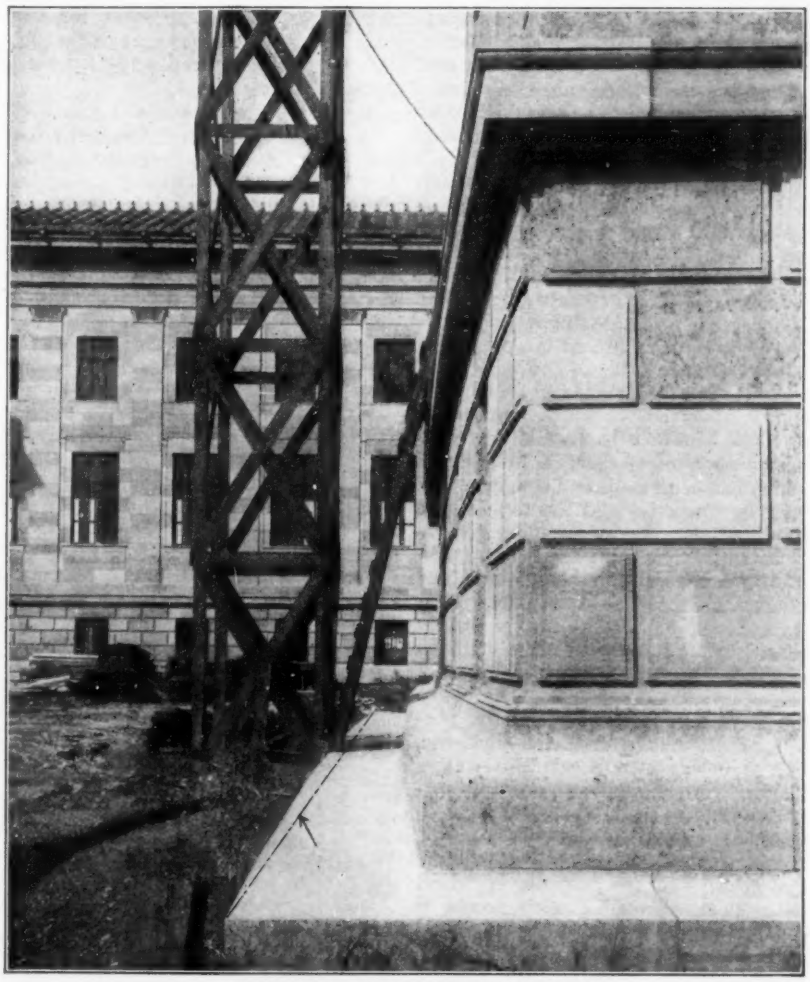
Later Greek and Roman builders stopped correcting these apparent architectural deformations because civilization became increasingly commercial and would not stand the expense.

The architects of Egypt also had observed this curiosity of optics and with great care built the cornices of certain of their temples so that they actually were curved. It is an interesting fact that while the Greek curves are traced in vertical planes the Egyptian arcs are contrasted in horizontal planes.

The use of curves instead of straight lines is not the only significant refinement in the Philadelphia structure. We usually associate Greek art with the cold classic walls and plain but ponderous columns, but here the Greek use of color has also been added to the design. For the first time since classic days pigments have been used to brighten solemn walls and columns.

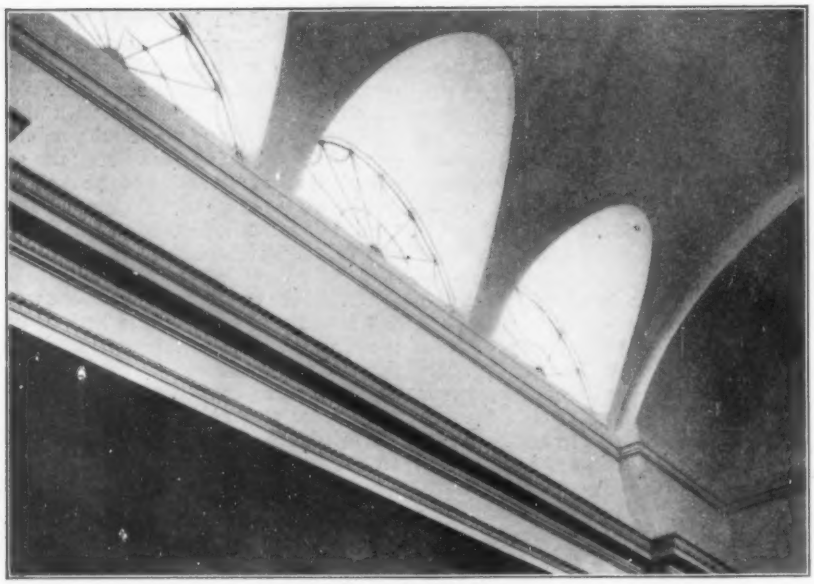
SINCE the use of gay decorations was a lost art, experiments had to be made to gage the visibility of flashing shades at a distance. All models were made to scale, cast in plaster, treated with color and gold, and then taken out of doors and hoisted 50 feet. It was found that radical changes had to be made in order to have the colors blend properly from afar.

The four acres of terra-cotta roof are glazed from deep blue to bluish-green and even the walls have pleasing shades of stone. Harmonious color combinations were worked out in advance. The stones were numbered



NOT A STRAIGHT LINE IN SIGHT

Taking their cue from the famous old Greek architects, the designers of the new Philadelphia Art Center have produced a structure pleasing to the eye, no matter how viewed. Note the dot-and-dash line indicated by the arrow, which shows the accurately calculated curvature of the building



INDIRECT LIGHTING

The lighting systems employed in the interior of the Art Center approach daylight in their effects. Above is illustrated one corner of a room, showing how reflected light is employed

as they came out of the quarry and they were set in position in the walls which had been spotted in advance.

The Museum is 551 feet wide and 423 feet deep. There are three floors above the basement and it is the largest building in the world built as a unit for museum purposes.

One of the modern refinements which adds a subtle but very important feature entirely in harmony with the ensemble is the method and mechanism of lighting.

Here the illusion of natural daylight is obtained by employing only Mazda "daylight" incandescent lamps. These lamps with their blue glass bulbs correct the light of ordinary bulbs to a color not as coldly white as outdoor daylight but to a hue which approximates that of natural light indoors which has been mellowed somewhat by window draperies and the tone of the interior decorations of the room. Nearly 1000 lamps are used to light the portion of the Museum now completed. The lamps range in size from 60 to 1000 watts, each definitely and designedly contributing its part in the lighting ensemble.

SOME are used in floodlight projectors above artificial skylights, others in coves concealed in ceiling ledges, while others are part of artificial windows but not one is exposed to view.

The large temporary galleries along the north side are partially ceilinged with glass, through which comes a glow of light, soft and diffused. Above each skylight section is a large housing painted white inside, which reflects back from many "daylight" lamps within. But little dependence, however, is placed on the skylight for the strong, discerning light that is essential for the gallery walls for only sufficient light comes through the skylight to make the ceiling softly luminous.

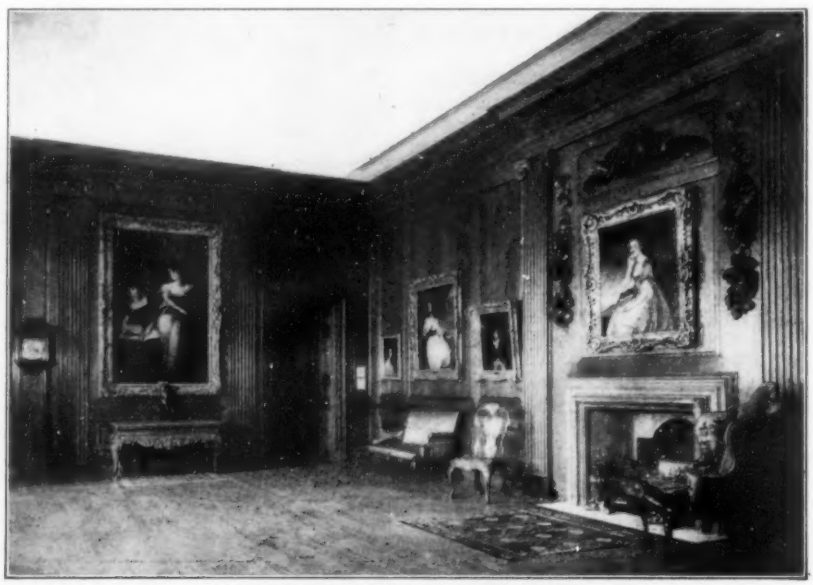
Bounding the glass ceiling area on all four sides are beams dropped a foot below the ceiling and extending both lengthwise and crosswise of the rooms about five feet from the walls. To all appearances these beams are simply supporting members of the ceiling structure but their primary prupose is to form the housing for the source of the gallery wall illumination. The sides of these drop beams toward the walls are of stippled glass sections behind which are concealed projectors so adjusted as to throw a flood of white light on the picture area. These projectors are spaced every two or three feet along the beams, and are mounted on swivel joints for aiming as desired. Each plays its own part in lighting a definite portion of the wall area.

Perhaps the most unusual treatment is manifest in the 10 period rooms—particularly so if we seek to emphasize the departure from architectural precedents so increasingly necessary if the full potentiality of lighting is to be gained.

THESE rooms are originals, four English, four American and two Pennsylvania Dutch, transplanted with meticulous care to this new stately building which crowns Philadelphia's Acropolis. There is the golden brown fumed oak wainscoting of Sutton Scarsdale with the tragic deathless loveliness of Lady Hamilton looking down from one great picture and other Romneys, Gainsboroughs, and Raeburns of the McFadden collection accompanying it.

When these rooms were reconstructed within the museum, a small space was provided between the museum walls and the outside wall of the rooms. This allows some diffusion of natural daylight to filter in through the inner windows, but by dropping a white curtain outside the room windows, a soft diffused artificial light is reflected into the room. Daylight lamps are hidden outside the window and direct their light to this curtain.

With its historic past and future potentialities, which have not been covered in this description, Philadelphia may well look forward to maintaining one of the great museums of the world.



ONE OF THE MANY PERIOD ROOMS

Furniture, paintings, and the like, from various periods are grouped separately, so that segregation is complete. In this room, as in others, the various pictures are individually lighted

Rocking Again the Cradle of Flight

Pioneers Celebrate In Hammondsport the Days That Made Aviation History

By MILTON WRIGHT

FOR 365 days a year Hammondsport, New York, has a population of 1000 quiet-loving souls. Last Fourth of July, however, there were 50,000 persons in the village, all Hammondsporters at heart. It was the 20th anniversary of the flight of the famous *June Bug*.

Let us go back to the early days of aviation as the Hammondsporters did in retrospect. In 1907, Dr. Alexander Graham Bell, inventor of the telephone, organized the Aerial Experiment Association for the purpose of carrying on experiments with flying machines. Dr. Samuel Pierpont Langley had invented his machine which met with disaster on what was to be its maiden flight; and the Wright Brothers had flown their machine on the sands of Kitty Hawk, North Carolina. Aviation had been born, but its swaddling clothes had not been made. It had to be nursed carefully.

Dr. Bell was a close personal friend of Dr. Langley and he decided upon Hammondsport as the cradle within which to rock the infant industry of aviation. In the group invited to carry on research and experiment work was Glenn H. Curtiss, who, since 1903, had been the outstanding American designer of light-weight gasoline engines. Curtiss had made several world records, most of them in connection with motorcycle racing. Since 1903, he had held the national motorcycle championship; in 1904, traveling more swiftly than any human being had ever traveled in any manner, he had established a world's speed record for ten miles which stood for ten years.

ALL of the dirigibles in the country were using Curtiss engines made in Hammondsport. This work had attracted the attention of the government and an order was placed for the first big dirigible balloon for the Signal Corps, thus marking the beginning of military interest in aeronautics in America. The balloon, driven by a four-cylinder Curtiss engine designed for the purpose, was built and tested in Hammondsport in 1905.

Because of his prior experience with engines and aeronautics, Curtiss was made director of experiments for the Aerial Experiment Association. Each member of the organization was to build and fly a machine after his own design.

On March 12, 1908, the first of a series of events took place which was to carry the name of Hammondsport around the world and write it indelibly in the history of aviation. On that date, Casey Baldwin, one of the members of the association, flew over the ice of Lake Keuka in his airplane, the *Red Wing*, designed by Lieutenant Selfridge, an observer for the United States Army and also a member of the organization.

Underwood and Underwood

AFTER TWENTY YEARS

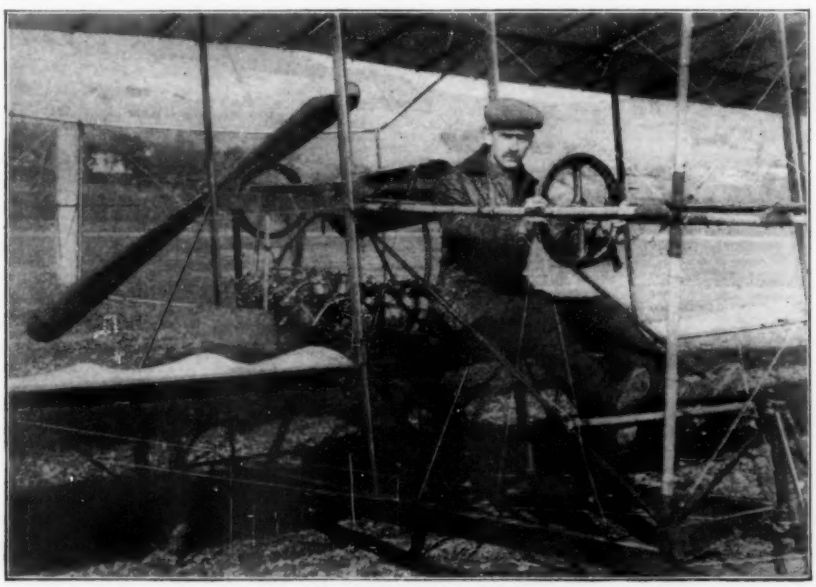
Augustus Post, old Aero Club representative, talks it over with Glenn H. Curtiss

On May 22, 1908, Curtiss flew the airplane *White Wing* a distance of 1017 feet in 19 seconds. This was achieved on the old Champlin Race Track. The *White Wing* was designed by Casey Baldwin.

ON July 4, 1908, Curtiss made his memorable flight of one mile in the *June Bug* of his own design to win the first leg of the SCIENTIFIC AMERICAN trophy. Of all the prizes he has won—and they are many—this is the one he values most highly. It marks the first pre-announced flight in America. This was the event whose anniversary was observed by the thousands of men and women interested in aviation who flocked to Hammondsport last July 4th to celebrate. Incidentally, this flight had exhausted the funds of the association.

Curtiss and the village of Hammondsport, however, had just begun to make aviation history. On July 17 of the following year, Curtiss won the second leg of the SCIENTIFIC AMERICAN trophy, flying 19 times around a circular course for a distance of 24 7-10 miles, at Mineola.

On August 29 of the same year, Curtiss won the Gordon Bennett International airplane contest at Rheims, France, with a machine and motor designed and built at Hammondsport, bringing to America the first international aviation speed trophy.



A PIONEER MACHINE

This photograph, taken when the Aerial Experiment Association flourished, shows Curtiss at the wheel of the Silver Dart, *a machine built at Hammondsport from motorcycle experience*

THE FLYING FIELD TODAY

The Finger Lakes Association representing most of western New York has chosen this site for the new airport to commemorate the work of the men who developed aviation at Hammondsport

On May 31, 1910, Curtiss flew from Albany to New York, down the Hudson River, winning the third and final leg of the SCIENTIFIC AMERICAN trophy, as well as a prize of 10,000 dollars offered by the New York *World*. This flight, of course, was among the many discussed by the old timers as they gathered at Hammondsport. The manner in which the public looked upon Curtiss those days is illustrated by an anecdote which Augustus Post, one of the official observers of 20 years ago, related at the anniversary celebration.

"IN his flight from Albany to New York," he said, "Mr. Curtiss was allowed to make two stops; the first of these was planned to take place at Poughkeepsie and the second at the upper end of Manhattan Island. In searching for a suitable landing field at Poughkeepsie, he found a large, flat, beautiful lawn. He went to the proprietor of the institution owning the ground and asked permission to land there. 'Certainly, Mr. Curtiss, we shall be very glad to have you land,' said Dr. Taylor, head of the institution, 'this is the place where they all land.' It was the State Asylum for the Insane."

In the same year, Curtiss and his associates made the first flights to and from the deck of a battleship. In November of that year, the Secretary of the Navy sent naval officers to Curtiss at Hammondsport for instruction in flying. In 1909 and 1910, numerous experiments with Curtiss flying machines were conducted on Lake Keuka. On January 26, 1911, the first successful flight of a hydro-airplane was made. In July, 1912, the first airflight boat was demonstrated on Lake Keuka. In May, 1913, flights of the first amphibian type of machine, designed to start from and alight on either land or water were made. These amphibian machines were flown by Lieutenant B. L. Smith of the Marine Corps.

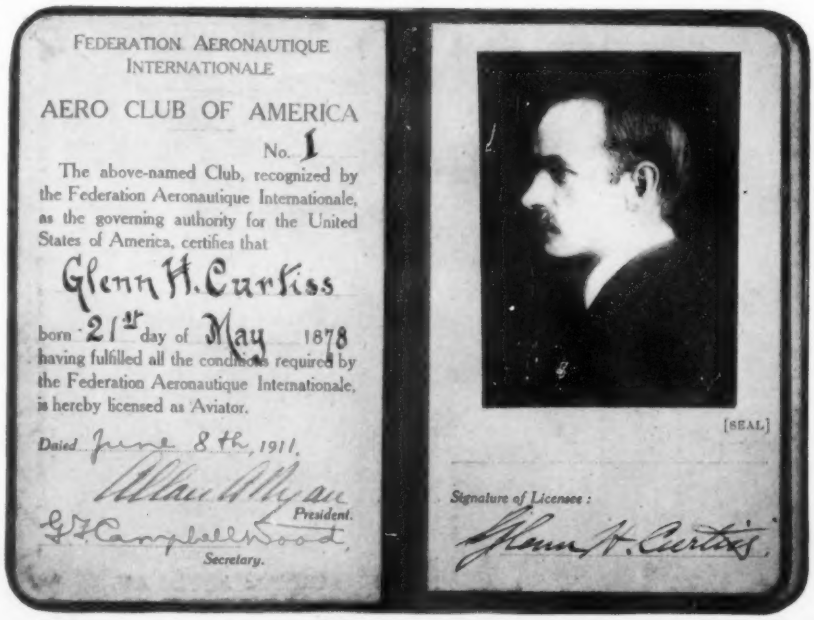
In April, 1914, the first tests of the twin-motored flying boat, *America*, were made. This was built for Rodman Wanamaker for a transatlantic flight test. It later developed into the famous *NC* type. The designation *NC*, by the way, stands for Navy-Curtiss machines.

In May, 1914, the famous Langley machine which had been wrecked in launching in 1903, was rehabilitated and brought to Hammondsport from the Smithsonian Institution. After its restoration, it flew under the supervision of Dr. Charles D. Walcott, secretary of the Smithsonian Institution. Dr. A. P. Zahm, scientist, and Charles M. Manley, one of the Langley engineers, supervised the original construction of the machine. The successful flight at Hammondsport precipitated the famous controversy between the Smithsonian Institution and the followers of the Wright Brothers which only recently has been ironed out.

With such outstanding achievements to talk over—to say nothing of the many experiments with tetrahedral planes, helicopters, ornithopters and other types of machines, and the work done by army and navy officers who had their baptism in aviation at the Curtiss camps—there is little wonder that the old timers waxed enthusiastic.

A STATE airport should be established at Hammondsport, they declared, not only to commemorate the work done by the pioneers in the "Cradle of Aviation," but also because aviation needs an airport at that particular spot. Hammondsport, they pointed out, is in an ideal location for an airport. It is on a direct air route from New York to Buffalo, from New York to Toronto, from Boston to Cleveland, from Pittsburgh to Syracuse. In other words, it is a convenient location for a necessary stopping place between cities on the eastern seaboard and the middle west.

The route across Hammondsport, the old timers pointed out, presents far more satisfactory flying conditions than do routes over the state of Penn-



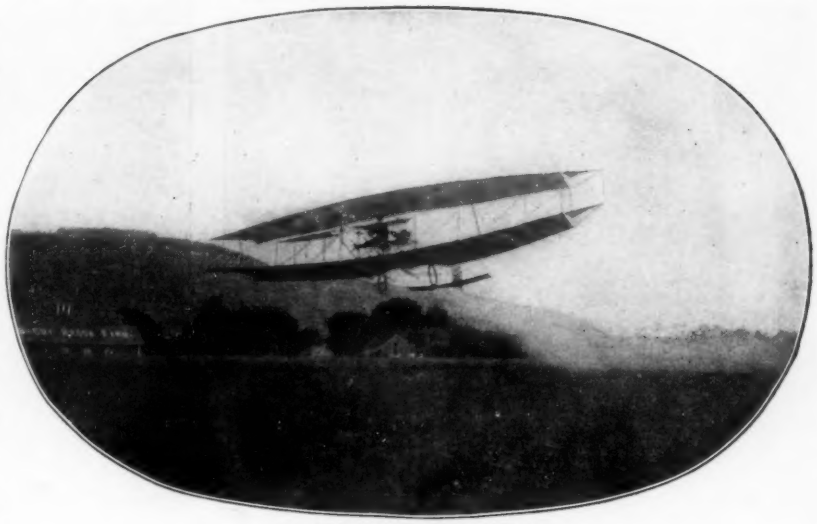
PILOT NUMBER ONE

When the Aero Club issued the first aviator's license in America seventeen years ago it went to the motorcycle speed king who had become a leading experimenter in airplane development

sylvania where the rugged mountains add to the dangers of flying. Then, too, they declared, there probably is no airport in the country as easy to find from the air as is Hammondsport, even in thick weather. It lies along the southern edge of Lake Keuka, a sheet of water 30 miles long. The lake is shaped like a giant Y and can be located readily, for no other lake looks just like it. In the wide valley planes are protected from dangerous blasts by high hills on either side. Then, too, if repairs or adjustments are needed, there are well-equipped plants at Hammondsport engaged in aeronautical manufacture. No community in the world is more air-minded than Hammondsport.

RECALLING the exploits of the past, the pioneers who labored together at Hammondsport began to plan for the future. Why not, they asked each other, revive the Aerial Experiment Association and carry on from where the old association left off? There are still problems in aviation to be solved. The solving of them may not bring money to anyone; they may bring a certain amount of glory, or they may not. But, at any rate, something ought to be done there. And who is better fitted for the task by tradition and by training than the men who received their education and their inspiration at Hammondsport?

There is no thought that the work which Glenn Curtiss and his associates began at Hammondsport has been discontinued utterly. The Army and Navy are doing constant research and development work for their own peculiar purposes. The company which Glenn Curtiss founded and which bears his name is doing wonderful research work in its experimental laboratories at Garden City.



THE "JUNE BUG" IN THE AIR

By making the first pre-announced flight in the world of more than one kilometer in a heavier-than-air machine, Curtiss won the first leg of the SCIENTIFIC AMERICAN *trophy, July 4, 1908*

There, for example, is a great wind tunnel, the only one in the country owned by a commercial organization. When any new plane is designed, a small model, scaled down with perfect accuracy, is first made. It is placed and pivoted in the center of the tunnel in all sorts of positions and subjected to all sorts of conditions which the larger plane would experience. Weights and balances measure accurately the effect of all the conditions on the tiny model and the designers know exactly what to expect when the larger plane is completed and sent into the air.

New motors are tried out, new materials originated, new shapes designed. The whole aerodynamic laboratory of the Curtiss Aeroplane and Motor Company is founded upon the belief that aeronautics is destined to become an exact science, requiring the solution of many intricate problems, the highest type of engineering talent and the finest of scientific equipment. The facilities of the experimental plant include a testing laboratory for making structural tests of aircraft materials and parts; a chemical laboratory completely equipped for chemical investigations of aircraft materials, heat treating, and plating, and containing other equipment available for research on processes; and a fully equipped model shop, as well as complete manufacturing facilities for test production.

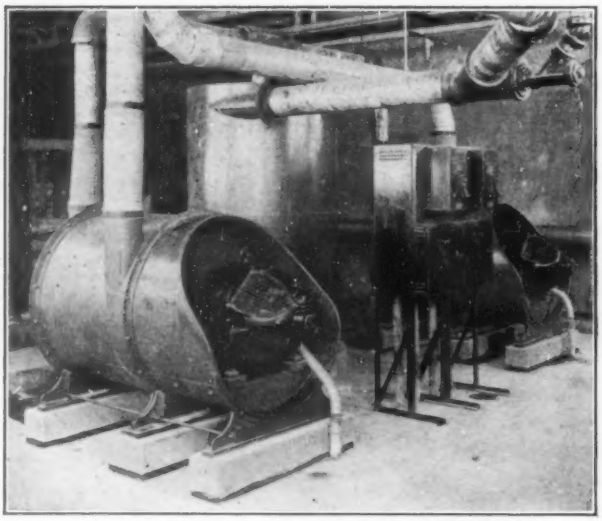
THE MEN WHO ROCKED THE CRADLE

Casey Baldwin, Lieutenant Thomas Selfridge, Glenn H. Curtiss, Alexander Graham Bell and J. A. D. McCurdy of the Aerial Experiment Association, and A. H. Post of the Aero Club

THESE things take vision—practical vision. But what of the fantastic dreams, of which nothing may ever come? Are they to be denied a place in the scheme of things? Great developments sometimes do eventuate from wild ideas. There are things to be attempted which the government and commercial organizations have no time to trifle with.

"We want to work with the 'pretty things' of aviation," said the old timers, "the radical things, the things that might be called visionary and impractical, but the things which may revolutionize the infant science of flying."

And how to accomplish this? How better, we might suggest, than by reviving the old Aerial Experiment Association, founded two decades ago by Dr. Alexander Graham Bell, the inventor of the telephone? Once more the infant industry could be rocked in the Cradle of Aviation. Hammondsport would not rest upon her laurels, but would send new wonders spinning through the clouds to amaze an earth-bound world.



A FIXED VACUUM SYSTEM CLEANS THE HOTEL

Dirt and litter are sometimes driven 1000 feet through the piping system to the dirt tank shown in the center between the vacuum units

A SECTION OF THE COFFEE SHOP KITCHEN

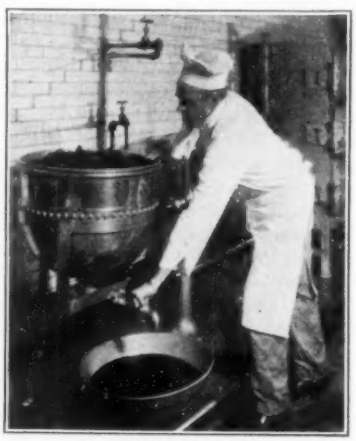
Each dining room has its own individual kitchen so that confusion of orders is eliminated. Banquet kitchens supply only banquets

FROZEN DESSERTS

Ice cream and frozen desserts are put in "cold storage" awaiting orders

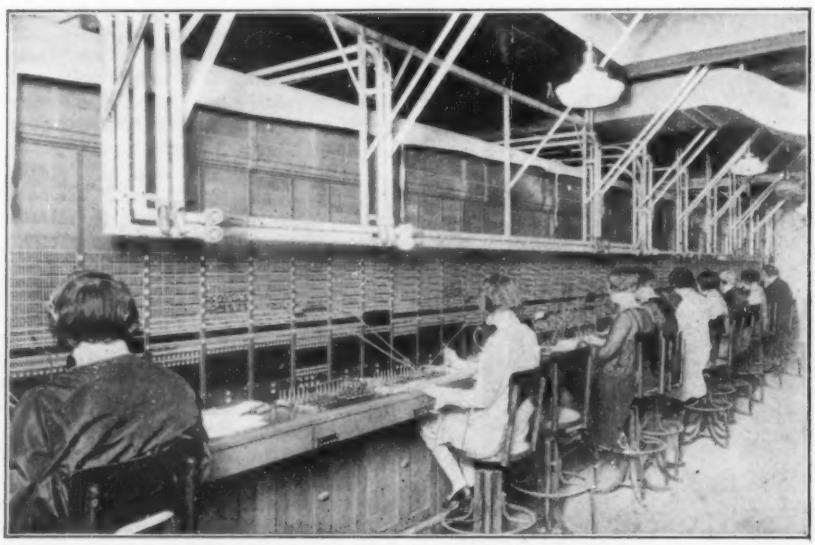
In the World's Largest Hotel

THE STEVENS at Chicago is the largest hotel in the world. There are 3000 rooms and 3000 baths. A whole convention can be provided for. Last September one of our editors attended the Congress of the National Safety Council and every meeting, the exhibition and the banquet were all held in this vast hotel on the lake front. This year the same number of meetings will be distributed among three or four hotels in New York. It is the idea of concentration which dominates the Stevens. The hotel is very luxurious, but we illustrate only a few of the mechanical features. The vast ballroom holds 3000 diners who are admirably served by special kitchens. The hotel cost the enormous sum of 27,100,000 dollars or about the same as the U. S. battleship *Colorado*.



PRUNES

Thousands are being cooked at once and the syrup saved for sauces



THE SWITCHBOARD WOULD SERVE A TOWN OF 15,000

Immediately at the conclusion of a call a record of the charge is sent to the office by pneumatic tube. There are 318 trunk lines and 3800 inside lines for the use of guests and personnel

PNEUMATIC TUBE TERMINAL

This may be likened to a telephone switchboard. Only guests give verbal orders

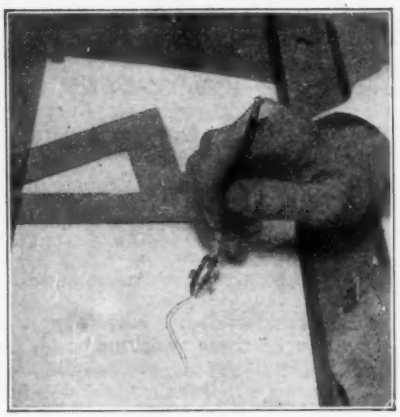
Drafting Aids

Tools Designed to Speed the Engineer's Work

Photographs Courtesy Eugene Dietzgen Company

SWEDISH RULING PEN

Holds large supply of ink. Graduated thumb screw allows duplication of width of line



DOUBLE CURVE PEN

Useful in railroad work. Makes double line. Swivel joint allows universal "play"

LETTERING PENS

Built with adjustable nibs like ruling pens for holding much ink. For very heavy lines

THE complaint that drawing instruments are not up to pre-war standards seems no longer to hold true. Manufacturers, besides striving to keep up the quality, are also alert to the possibilities of new designs to save time, temper, fatigue, and guess-work. Illustrated on this page are a few able assistants to the draftsman.

With the Swedish pen shown in the upper left hand corner, any line width may be obtained by setting its graduated thumb screw; the setting can be remembered, and the line thus duplicated later. The photographs of the double line pen and the two lettering pens are self-explanatory.

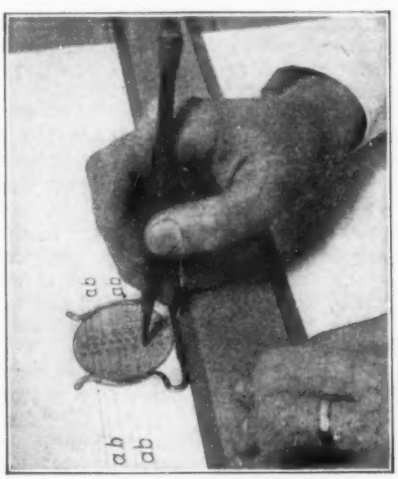
In the center illustration, the upper pen has an extra nib, thus forming two ink reservoirs so that long lines may be drawn without refilling. The nibs of the center pen are adjusted by turning the milled cap on top of staff to raise or lower a wedge between the nibs. One blade of the lower pen swings out for cleaning without affecting adjustment.

RULING PENS

Top: *Increased ink capacity due to third nib.* Middle: *Adjusts by turning milled top cap.* Bottom: *Nib turns so that it may be cleaned without disturbing setting*

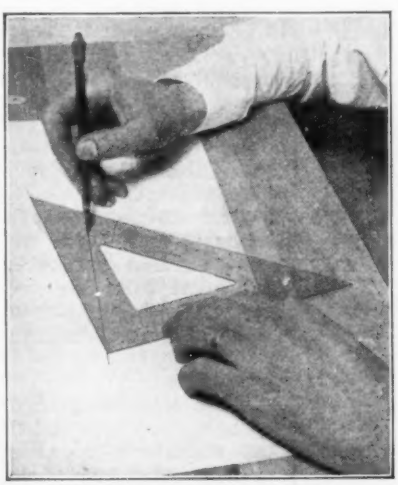
The lettering device consists of a celluloid disk in a metal frame. Disk may be rotated and set by graduations on its edge, for horizontal spaces varying by 1/32 of an inch. Upright guide lines at 68 or 75 degrees are drawn against its base while it rests on its side on the T-square.

The protractor-triangle is a two-in-one instrument. In the self-adjusting bow pen, the point is on a center shaft which remains stationary while the pen rotates freely around it. It is particularly efficient for drawing very small circles such as are necessary in the design of steel girders, et cetera, where rivets are shown.



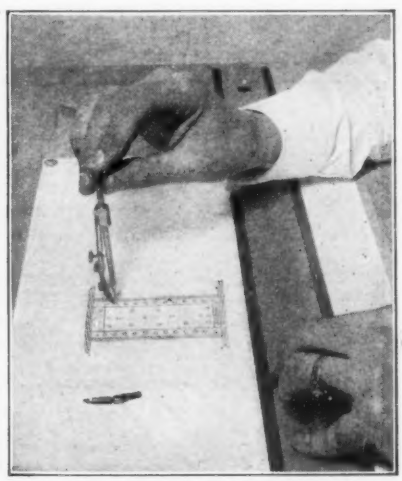
LETTERING DEVICE

For drawing horizontal and upright lettering guide lines. Text tells how it is to be used



PROTRACTOR TRIANGLE

The pencil points to the curved protractor scale. Line is drawn at the triangle's edge



SELF-ADJUSTING BOW PEN

Adapted to drawing of small circles. Needle on center rod remains stationary

Rendering Visible a Magnetic Field

An Account of the Accidental Discovery of a Peculiar Phenomenon Which May Later be Set to Practical Work. The Experiment May be Duplicated by Amateurs

By ELIHU THOMSON, Ph.D., Sc.D., LL.D.
Director of the Thomson Laboratory of the General Electric Company
Corresponding Editor, SCIENTIFIC AMERICAN

IT sometimes happens that a most inconspicuous phenomenon presents itself in the course of ordinary work which might easily pass unnoticed were it not for a habit of close observation acquired in laboratory practice. I propose to describe, in simple terms, an instance leading to the discovery of a "Novel Magneto-Optical Phenomenon," in 1921.

At the River Works plant of the General Electric Company, situated at Lynn, Massachusetts, a large building is devoted to the odds and ends of operations which enter into the construction of machinery, including such operations as the oxy-acetylene cutting of large plates of steel into various shapes, and the welding by oxy-acetylene blow-pipe and by electric arcs of parts of structures or machines to be finished in other parts of the Works.

THIS work was spread through the building, and here and there was to be found in operation an electric resistance welder using the Thomson process. In this latter form of welding very large currents are applied to the work without any arc, and the resistance of the work to these large currents provides the heating effect which enables parts to be heated, pressed together, and welded. Naturally, the operation of these resistance welders under very heavy current would produce in the space near them intense magnetic fields appearing when the current was on, and disappearing when the current was turned off.

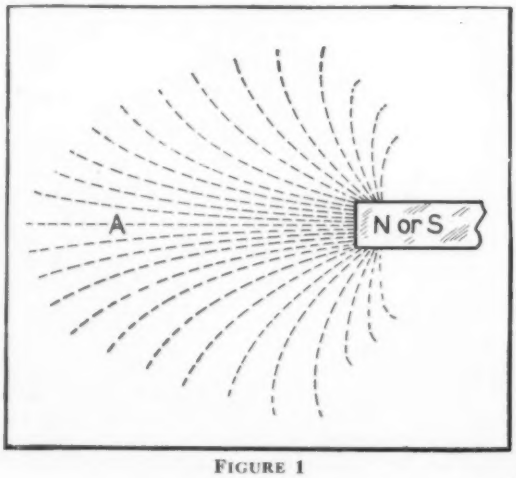


FIGURE 1

Having thus briefly outlined the conditions of environment in the building, we may proceed with our story.

Early in April of 1921 it was noticed at the building which we have briefly described, that in operating an electric welder in which the very heavy welding currents were interrupted at intervals, a peculiar intermittent and widespread illumination of the space around was produced; faint indeed. The sunlight was coming into the room through windows back of the welder, and the direction of sunlight was on an angle downward from the sky above, corresponding to somewhere near the middle hours of the day.

I was called to observe this peculiar intermittent illumination of the space around the welder; a truly mysterious happening, such a thing as would be most unexpected. It was seen that the conditions existing were, as stated above, that the room illumination came in on an angle downwards from the sunlight entering the windows, and that a weak magnetic field extending from the welder came and went with each establishment of the welding current and its interruption.

This was a common enough condition in the use of electric machinery or apparatus, but whence the luminosity? A ghostly glow appeared through the surrounding air, manifestly dependent on the existence of the magnetic field of the welding current following its fluctuations; but why was this present in this particular instance and not in others in which all conditions, so far as known, were similar?

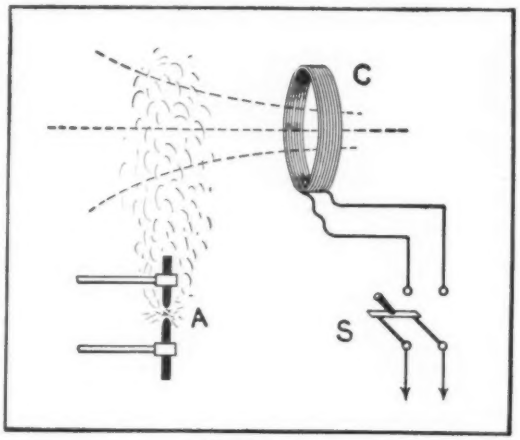


FIGURE 2

After confirming by careful observation that the appearances were real, although faint, I asked myself the question, "What is there about this building or the room in which the welding machine was operated that is different—what difference of environment, if any, exists from the ordinary surroundings?"

IN a large open space in the building, electric-arc welding with iron arcs was carried on at times, many feet away. It was conceivable that the smoke or fumes from the arc might diffuse themselves through all the spaces in the structure. So far as we knew, this was the only difference between the conditions here and elsewhere.

If our supposition that the luminous effects were due in some way to iron smoke was correct—and we took care thoroughly to ventilate the building—the curious luminosity should disappear. Actually this was found to be the case. It was then decided that the smoke of iron arcs, the minute particles

of oxidized iron or its vapor, floating imperceptibly in the air must constitute the difference for which we were looking.

Evidently then, the condition for observation of this new effect involved the presence of iron smoke, together with light falling on the smoke, and

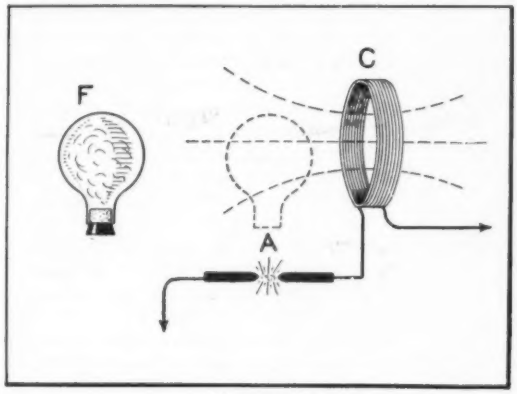


FIGURE 3

that we should view it across the light into a somewhat darker background. There should also be a magnetic field, the lines of which crossed both the direction of the light and that of viewing. In other words, the line of sight should intersect both the light direction and the direction of the lines of the magnetic field present.

It might be supposed that the particles of iron or its oxide floating in the air were instantly lined up in much the same fashion as iron filings in a magnetic field, but in a more intangible and ephemeral sense. On the disappearance of the magnetism, they must fall into their original confusion at once and resume their helter-skelter suspension. The peculiar luminous effect would then cease.

THE accompanying Figure 1 exemplifies the simple conditions required to produce the novel effect as first observed. Let "N or S" be the north or south pole of a magnet giving a field of force shown by the thin lines emanating from the pole. Now if a beam of light comes down from above so as to illuminate the space in which the field lines exist, and we look across this field from a direction vertical to the paper, we see nothing unusual, but if iron smoke, even very dilute, as from an iron arc or spark, is present in the space "A" of the field, there is seen a luminosity not present before.

A better way of exhibiting the effect is to use, instead of the magnet, a coil of wire or an electromagnet, through which latter a current, either alternating or direct, can be intermittently sent by the opening and closing of a switch. This is equivalent to putting in place or taking away the magnet pole "N or S," (Figure 1). The effect is then very marked.

It is well known that light reflected at certain angles from surfaces or particles suspended in a gas, such as air, will be found to be polarized, more or less, a test which is often resorted to in order to discover the effects of sunlight in passing through the atmosphere or upon being reflected from surfaces, such as that of the sea, or even of the foliage of trees. It is natural, therefore, that early in our observations with the new effect of the luminosity, examination was made by a Nicol's prism (used to view the same in various directions). The light was found to be polarized as it should be, according to optical laws, when emanating from lines of particles, or strings of magnetized particles lined up in a magnetic field.

One of the simplest ways of demonstrating the novel effect, and which is easily reproduced by anyone to whom ordinary electric current supply is available, is illustrated in Figure 2. "C" represents a coil of insulated wire which may be an open coil or which may surround a core of iron. Its purpose is to establish a magnetic field in the space around it, chiefly through its axis. Either direct or alternating current may be sent through it. A switch "S" is provided to cut off or put on the current.

AT "A" an arrangement for producing an iron arc exists, and this may be operated by either direct or alternating current. If the currents for the coil "C" and the arc at "A" are derived from a lighting circuit at ordinary voltage, care must be taken to have a sufficient resistance or impedance in the circuit with the coil and with the arc to prevent the flow of excessive current such as would blow fuses in the system of supply. It is not essential that an arc be maintained at "A." It suffices that interruptions between iron wires be made such that sparks are given from which iron fumes or smoke arise. Having arranged this apparatus before a window so that the light may enter the field from above, it will be seen that in the presence of the iron smoke floating upward in front of the coil "C," when the switch "S" is closed, the stream of smoke particles becomes apparently luminous, an effect which is absent when the coil "C" is cut off by opening the switch at "S." The effect is best seen when a fairly rapid opening and closing of the switch is made. The light in the field of the coil is then seen to flash or intermit in harmony with the switching movements.

If the direction of viewing be changed so that one looks along the axis of the coil or in the direction of the lines of force themselves, the effect is absent. The rotation of a Nicol's prism about its axis, through which one looks at the smoke in the magnetic field, shows at once that the light from the smoke is polarized, as before mentioned. This examination by the prism shows also that the smoke stream itself is composite. A bluish constituent of the smoke shows no polarization effect, while a yellowish-gray fume appears in viewing by the prism as extinguished or not, according to the position of the prism as rotated.

IN the course of our experiments we found that the iron smoke could be bottled up in a clear glass flask or bottle of, say, two liters capacity, and this receptacle when introduced into a magnetic field, and with a beam of light directed on it, will suffice to show the phenomenon, especially if the magnetic field is fluctuating, at which time there will be seen a flickering light in the flask or bottle corresponding to the variations of the field.

The particles suspended in the air of the flask are naturally heavier than air and will in time settle out, but it is astonishing indeed how slow this process of subsidence is; a fact which testifies to their extremely fine state of subdivision.

The coil "C" in Figure 3 is set up to produce a field by passing an interrupted or low-frequency current through it. The flask "F" containing iron arc smoke is held at different distances therefrom while illuminated by a light source from above. The flask has been held over an iron arc so as to receive the fumes and it is then corked.

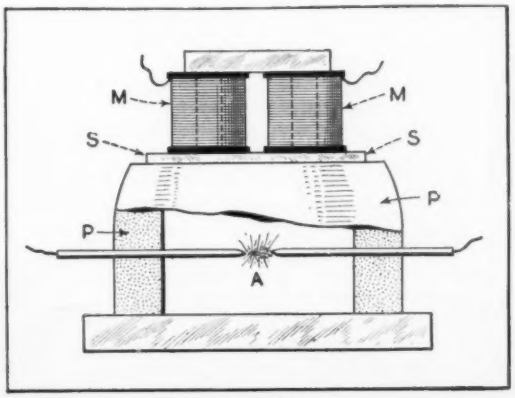


FIGURE 4

With a steady current in "C" the diffused luminosity in "F" is steady. With an interrupted current in "C" it flickers with the interruptions. With a low-frequency current in "C" (say four to six cycles) the flask shows little flickering when near the coil, but this effect is more decided when the flask is removed further away. We have noted it even at a distance of 12 feet away from a coil seven inches in diameter and two inches thick in axial direction. The flickering keeps time with the alternations of current in the coil.

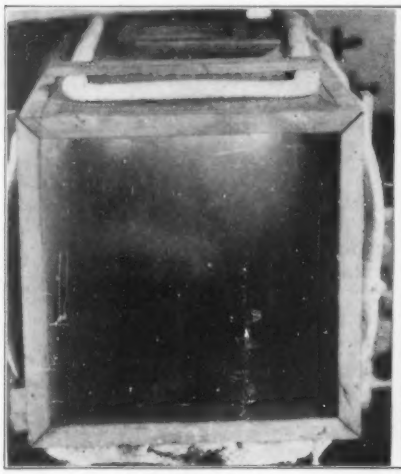


FIGURE 5

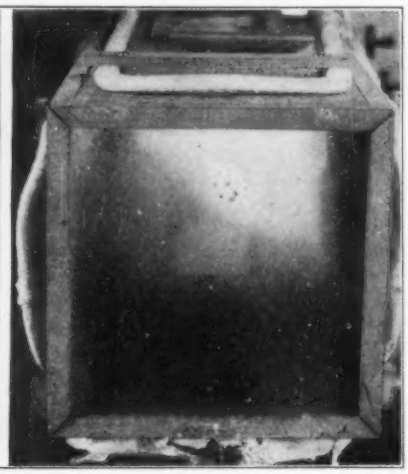


FIGURE 6

It is even possible to use the coil as an inductance and make and break its circuit at "A" while connected to a source of current, such as a 12-volt battery, or to the house current. This gives an arc or spark at "A" which with iron wire electrodes emits the smoke desired and which smoke can be caught in the flask by holding the open mouth over the spark gap in quiet air.

IN order to obtain some idea of the nature of the particles in the iron arc smoke, which, in a magnetic field are lined up or oriented so as to produce the luminous effect described, and the polarization of the light from the particles, an arrangement was made to receive the smoke upon a glass slide so that it could be examined by a microscope.

Figure 4 shows the arrangement used. "P, P" is a hollow cylinder of plaster of Paris for a support to the iron wire electrodes for forming an iron arc at "A." "S, S" is a glass microscope slide or other glass plate laid across the opening at the top of "P, P." "M, M" represent an electromagnet which can be energized by an electric current through its windings.

If the iron arc is drawn at "A" for a second or two, while the magnet "M, M" is without current (unmagnetized), the under side of the slide "S, S" receives a deposit of a light brownish powder without any visible arrangement or structure. If, however, the magnet "M, M" is excited by current when the fume or smoke is depositing on the slide, and such deposit is examined, it is found to have a striated structure, the striations joining the positions of the poles of the magnet, as is the case with iron filings used similarly, although the particles in the smoke are exceedingly small, requiring high powers of the microscope to show them. They consist of strings of very small round globules of iron oxide, presumably ferric oxide, with an occasional group of much larger globules strung together in line and having at each end of the group fine-grained tufts of the oxide itself.

These larger particles strung together, usually by threes only, are evidently metallic iron. The slide itself behaves with polarized light as do the particles in the air, except that they are now immovable or fixed on the slide and retain their arrangement in striae or lines. The slide itself becomes, as it were, a polarizing structure for light. Between crossed Nicol's prisms the fine-grained tufts just mentioned become luminous on the dark field.

Since in electrical engineering we are constantly dealing with magnetic fields invisible to us, which fields are either established or extinguished by the passage of current or its being cut off, and since in certain forms of apparatus of very great importance indeed in electrical development we deal with magnetic fields which are moving or shifting or rotating, it becomes evident that any means for rendering visible such fields may at least be of much value in studying the actions and reactions in such apparatus as generators, motors and transformers.

It is also quite conceivable that even at relatively high frequencies of motion, when making use of stroboscopic methods, or, as it were, slowing up effects, one might employ the luminous magnetic field still more extensively. There has not as yet been any great amount of work done in this direction, but it may suffice to introduce here brief descriptions which are typical of the way in which the novel effect may be used.

LET us refer here to Figures 5 and 6, which are photographs of a piece of apparatus for showing the novel effect. In both Figures 5 and 6, the same box with glass front and back for allowing light to pass through from back to front is seen surmounted by an open coil of insulated wire of rectangular shape. Iron smoke from an arc is allowed to enter the box from below. Figure 5 shows the photographic effect when no current traverses the coil, while Figure 6 clearly shows the luminosity produced within the box when a current in the coil gives rise to a magnetic field in the space within the box. Without doubt, such apparatus is susceptible of a considerable amount of development and improvement in its detail.

The apparatus shown in Figure 7 is indeed a simplified structure, involving the principles of three-phase current action whereby the rotating field produced can actually be rendered visible. Figure 7 is a photograph of this apparatus in its simple form.

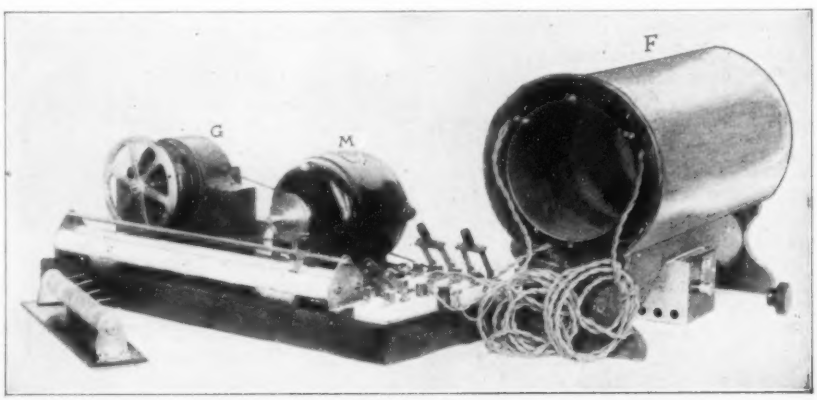


FIGURE 7

A motor "M" drives at slow speed a small generator, "G," of three-phase currents, which, through suitable switches and connections, are led to a cylinder "F" of insulating material such as wood, embodying on its exterior a winding, three-phase in character, whereby a rotating field may be produced within the cylinder. This latter is a free space with a glass plate back and front for confining the smoke from an iron arc, arrangements for producing which smoke are seen to the right extending under the body of the cylinder.

Suitably illuminated from the back when in operation, the apparatus permits the revolutions of the field within the cylinder to be seen clearly.

The apparatus allows the speed of rotation to be varied, and the direction of revolution reversed as desired by the simple manipulation of the switches provided. It is evident that in this way it is easy to arrange to show the effect of moving fields or distortions of magnetic fields by iron or by current-carrying coils in such fields.

THE principles above described may be, of course, varied widely, and apparently with no particular limit. Also, the scale of operations may be very small or they can be extended to cover large apparatus and large spaces; in fact, in the original observations which call attention to the presence of the phenomenon itself, it may be said that the experiments were made on quite a large scale, since the field of the welding coil involved extended many feet therefrom, while the illumination of the iron smoke was diffused through quite a large portion of the room. It could easily have been the case that if the scale of operations had not been quite as large, the effect itself might easily have gone unnoticed.

There seems to be no consistent theory to account for the peculiar column of light seen in the western sky after sunset, particularly in the tropics, and known as the "Zodiacal light." If we assume, however, that the corona around the sun, always existing but seen only at the time of a total eclipse, extends in a diffused way without limit into the surrounding space, and is partly composed of or accompanied by fine particles, such as fine solids from condensation of vapors arising from the sun's atmosphere and perhaps propelled outward by the pressure of the intense solar radiation, we may form a hypothesis which seems to be consistent with our observations. As the spectrum lines of iron are prominent in solar light, it might be expected that in the space around the sun fine particles of iron would constitute, at least in part, those escaping streams from the sun, densest in the plane of the ecliptic. The earth would naturally be immersed in them.

If such particles could be of the same or of similar nature to the iron smoke particles, they might line up in space by the magnetic field of the earth when near enough to the earth. Then the Zodiacal light, seen best at places near the equator and at times of vernal and autumnal equinoxes, might be understood.

The broken lines in Figure 8 would represent, in a crude way, the magnetic field lines about the earth. Figure 9, being a view in the line of the axis of the earth, shows by dots the cut-across lines of magnetism in the equatorial plane.

Now assume that the sun's light, indicated by the arrows and broken lines. (Figure 9), comes up from below, and that in the direction of the magnetic lines, particles of iron (even ultra-microscopic) are lined up by the earth's magnetism in so far as to behave in the same way, but millions of times more feebly, as do the iron particles in our experiments. In this case, an observer at "A" on the night side of the earth looking outward to "C" and all the way up to "D" would perceive a faint luminous pillar of light in the sky. A glow would be seen in the sky even as late as 9 P.M. or later, and this would be repeated a few hours before dawn as if an observer was at "b" looking toward "e" and "f." The effect would extend outward from the earth as far only as the field was strong enough to orient the particles, and would, of course, depend also on the density of the particles themselves at various heights above the earth's surface, while they would naturally have a tendency to move toward the earth both by magnetic influence and gravitation. There has been no attempt to represent in Figure 9 any gradation in density. The angular altitude at which the light can be seen in the sky after sunset might give some idea of the extent upwards from the earth of the particles oriented by the field.

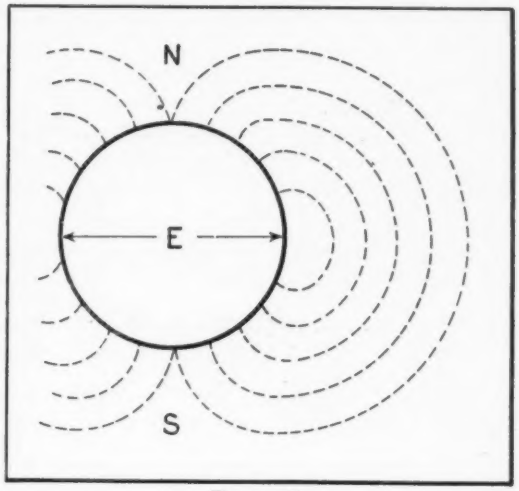


FIGURE 8

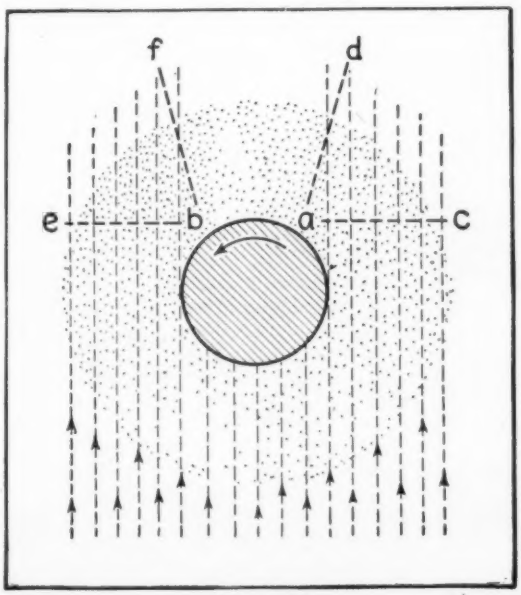


FIGURE 9

Examination by the polariscope should give similar results to those with the iron smoke, if the causes are the same.

Since the Zodiacal light must come from a great depth of space and its luminosity at best is low, an exceedingly small density of iron particles would suffice for producing the effect, a density perhaps very many millions of times less than the thinnest iron smoke ever present in the most feeble of the effects produced in our experiments.

The significant facts are that the direction of viewing is transverse to the direction of both the sun's beams and the lines of the magnetic field, in both cases. More and varied observations and experiments are certainly warranted in this fascinating field.

¶ *To the scientist the evolving concept of the atom means simply that we are gradually learning. In an early issue Dr. Paul R. Heyl will endeavor to make clear to the layman just how the new wave-atom is to be thought of.*

Three Years Abaft the Mast

What the Non-magnetic Ship "Carnegie" Is Doing for Science On Her Three-Year Cruise

By JAMES STOKLEY
Science Service

BORN in Kansas, a graduate of one of the universities of his native state, which he never left until he was grown, never having seen the ocean until he was 24—surely one would not expect such a man to become the commander of one of the most peculiar vessels that ever sailed the seas, and to pilot it safely for 160,000 miles to all parts of the globe. But that description fits a man who has embarked on a voyage which will not be finished, according to present plans, until July, 1931.

Captain James P. Ault is the man—commander of the Carnegie Institution's non-magnetic ship *Carnegie*. Although he was born in 1881, only a touch of gray at his temples betrays the fact that he will be at the half-century mark when the present cruise of the *Carnegie* ends. For Captain Ault is the sort of man who remains perpetually youthful. He has made ready for the present cruise with as much enthusiasm as he probably displayed in 1905, when he made his first voyage on the United States Coast and Geodetic Survey's ship *Bache*, from Norfolk to Panama.

This voyage was made in preparation for his later trips. At Baker University, in Baldwin, Kansas, he had acted as magnetic observer for the Coast Survey—watching the slight variations of a sensitive magnetic needle, to enable compasses to be used more accurately. Later in the same year as the *Bache* cruise—the year that he first saw the ocean—he sailed on the brigantine *Galilee*, which the Carnegie Institution had chartered, and which sailed for 73,000 miles, continually making observations of the variation of the earth's magnetism.

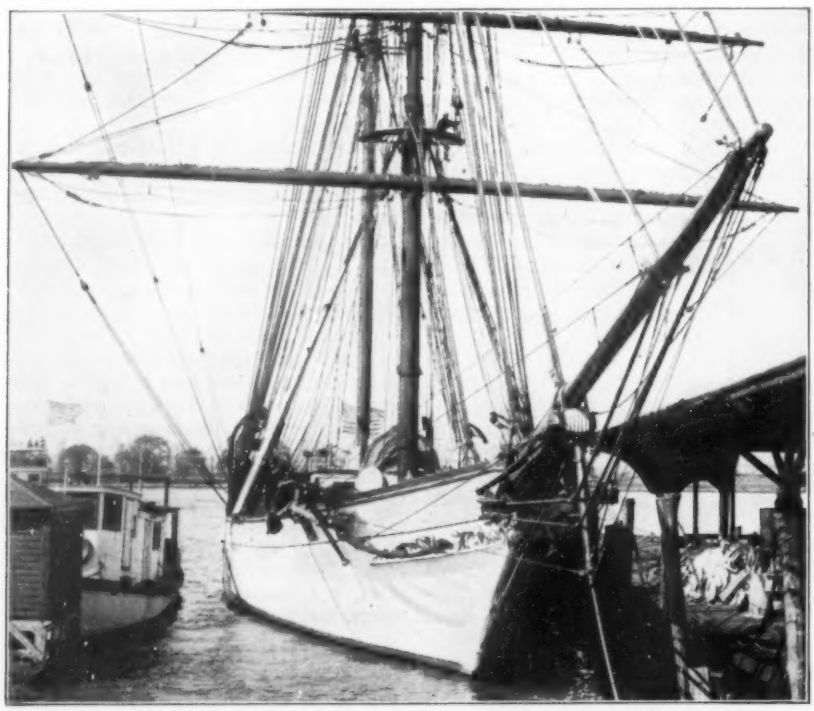
ALTHOUGH the *Galilee* was a wooden ship, it had a good deal of iron in its hull, iron and various pieces of magnetic hardware. As these introduced uncertainties in the measurements, the ship *Carnegie* was constructed with the wood held together with bronze nails and with bronze or other non-magnetic metals replacing iron and steel wherever possible. In 1914 when the *Carnegie* commenced her third voyage Captain Ault took command, and he has retained command on all subsequent voyages, with the exception of a short one in 1917.

In his work Captain Ault is following the footsteps of Columbus, for it was Columbus who first noticed that there is such a thing as magnetic declination. Except in a few places on the earth, the compass does not point north. In the eastern part of the United States, it points to the west of the true north as measured by the stars. In the west, it points more to the northeast. The angle by which it deviates is called the magnetic declination. If you follow the compass needle to the place toward which it does point, you will find yourself north of Hudson's Bay, at the north magnetic pole, but with the geographic pole about 1000 miles farther north.

"COLUMBUS must certainly have been a resourceful leader and expert navigator," said Captain Ault before his departure on the *Carnegie*. "Do you know that the course he selected is exactly the same one that we would choose today in making the same voyage? Then, before he left the Canary Islands, he changed the rig of one of his ships from fore-and-aft to square rig. This shows that he knew he would sail in the region of the 'trades' with fair wind." When Captain Ault talks about sails, he speaks with authority, for the *Carnegie* is one of the few square-rigged ships still

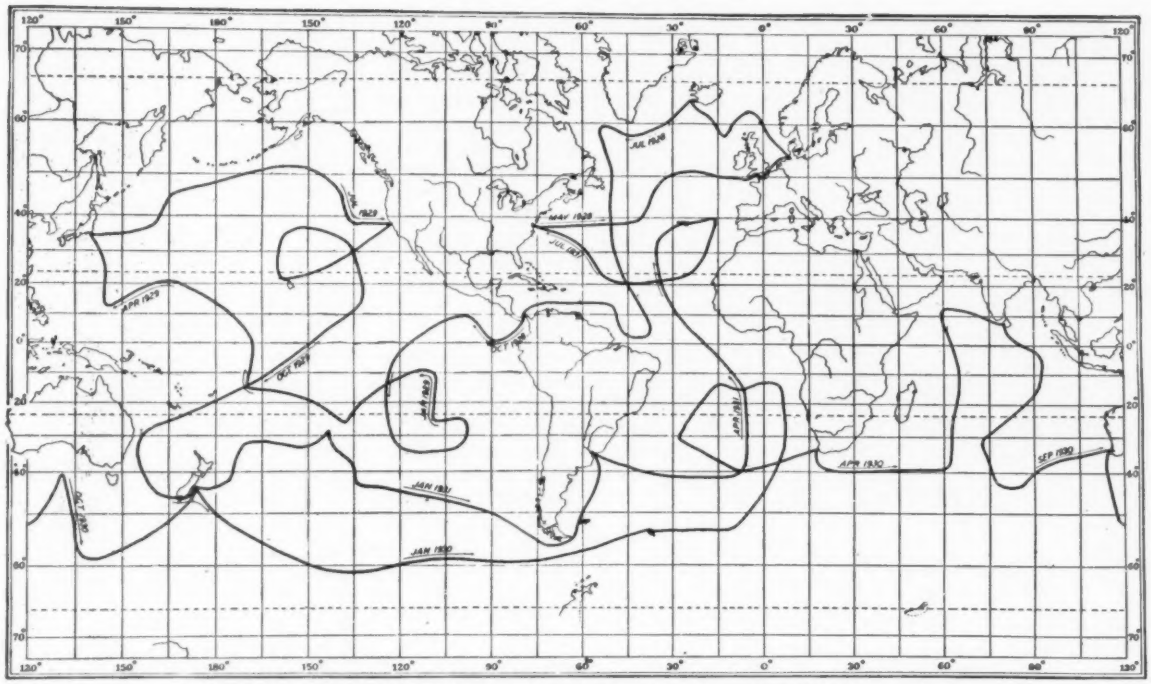
Why the "Carnegie" Cruises

ALTHOUGH the *Carnegie's* cruises are, in themselves, no longer news, so many misstatements concerning their scientific purpose have appeared from time to time in the newspapers that the editor publishes the accompanying article in order to set before the readers of the SCIENTIFIC AMERICAN an accurate, authentic account of the research in pure science which is being conducted by the scientific staff of the vessel. Mr. Stokley, the author, himself a scientist, enjoys the confidence of the seaman-scientist commander of the *Carnegie*, and he here points out plainly the purpose of the many kinds of observations to be made throughout the long cruise.



THE NON-MAGNETIC SHIP "CARNEGIE," OF THE CARNEGIE INSTITUTION OF WASHINGTON

Strictly speaking, the Carnegie *is not a "ship" but a brigantine, square rigged on the foremast and schooner rigged on the mainmast. This is considered the most comfortable rig in a seaway*



THE INTRICATE ROUTE OF THE "CARNEGIE" ON HER PROLONGED CRUISE

This and the equally circuitous routes of her previous cruises, cover the seven seas almost with a fine-toothed comb

afloat in these unromantic days of steam.

What is the use of such a voyage as the one now being made by Captain Ault? Such a question is often asked him.

"Well," he says in reply, "the oceans cover such a large part of the earth's surface that it is most important for us to know something of what is in them, and their physical condition. This is particularly true for some of the problems relating to the physics of the earth as a whole—what we call the science of geophysics. Our very life and environment and the evolutionary processes in the world are influenced in countless ways by the changing physical properties of the ocean.

"In the geophysical problems that we will study on our next cruise, those concerned with the earth's magnetism and electricity and with oceanography, much information has already been collected, but the work has really just gotten a start. The oceans are so vast that there is still plenty to be learned. We still know very little about the origin of the magnetism and electricity of the earth. We don't know how the two are related, and we are anxious to get more information as to their connection with such phenomena as the northern lights and radio transmission. Out at sea, away from the disturbances that often occur on land, we can make observations that will help us to greater knowledge of these things."

But magnetic and electrical observations are different from those made by the geographer, for example. When he goes into an unknown country, and accurately measures the contour of a mountain, it can be put on maps. Perhaps a century later the maps may still be used, for, barring such catastrophes as earthquakes or volcanic eruptions, the mountain will then be substantially the same.

TO know about the earth's magnetism, however, requires continual observation. Columbus landed in 1492 at what is now called Watling's Island. But if he were to make the voyage today and follow the same compass-course it would take him to the island of St. Thomas, 660 miles to the southeast. In 1699 the great English astronomer, Edmund Halley, made one of the first ocean magnetic surveys on the *Paramour Pink*. Part of his voyage took him from the Cape Verde Islands to Rio de Janeiro. If he were to follow the same compass course today he would not get within a thousand miles of the same place.

One does not need to go even as far back as Columbus and Halley. In 1911 the *Carnegie* herself sailed from the Cape of Good Hope to Colombo, on the island of Ceylon. Today, the same compass-course would bring her to the mainland of India, 175 miles to the west, completely missing the island.

The result of this is that ocean-surveys must be repeated regularly, and it is on this account that the *Carnegie* will retrace much of her former routes. The information thus obtained will not only help in theoretical studies of the earth's interior, but it will have immediate practical results. The two cruises of the *Carnegie* in 1911 and 1920 in the Indian Ocean showed that in the central part the compass was changing as rapidly as a third of a degree a year. Before the first of these voyages, this was not known, and so the charts for the region were more than five degrees in error. Such an error could easily mean hitting submerged rocks instead of passing safely through a channel between them.

"Side by side with the study of the earth's magnetism, we are studying the electrical field of the earth," says Captain Ault. "The importance of these investigations has increased in recent years because of the close relation between variations in atmospheric-electric and earth-current phenomena and variations in magnetic conditions. And the newest theories of the nature of electricity and the constitution of matter, as well as the great advance in radio communication, give added stimulus to the electrical studies. Because of the close connection between sunspots and solar activity in general with these effects we include the sun also, and last year we started to work in co-operation with the Mt. Wilson Observatory, of the Carnegie Institution, in these investigations.

"The electric elements which we are investigating include potential gradient, both positive and negative ionic content, conductivity and ionic mobility, penetrating radiation and radioactive content of the air. The potential, or electric charge, of the air increases with height above the earth's surface. At a height of a meter, it is about 100 volts. This is what we call the potential gradient. We measure it by raising a metal collector, installed at the stern of the boat, for a height of one meter, and noting the change in

Science Service

CAPTAIN AULT, IN COMMAND

He combines a rounded knowledge of science with a practical knowledge of navigation and seamanship, gained by experience

an electrometer connected to it. There are present at all times in the air the positively and negatively charged particles that we call ions. Ordinarily there are about a thousand of each kind in a cubic centimeter (about a sixteenth of a cubic inch) of air. With our instruments we can count these with fair accuracy.

"Closely connected with the number of ions in the air is its electrical conductivity, that is, its ability to carry a current. To measure this we force air past a charged conductor at a uniform rate of speed, and measure the rate at which it discharges.

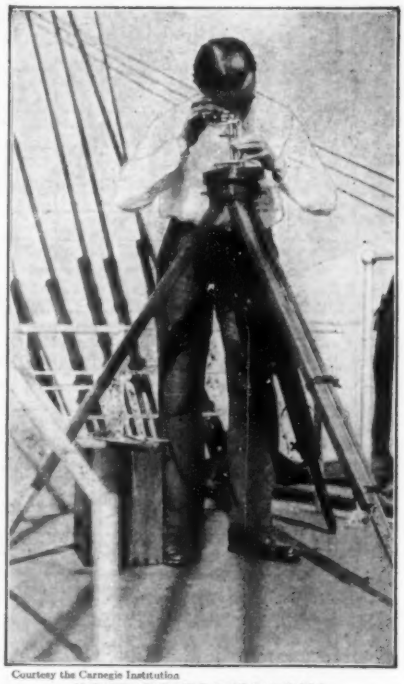
"ANOTHER thing we want to find out concerns the penetrating or 'cosmic radiation' that Professor Millikan has been investigating in recent years. These rays are coming into the earth's atmosphere from outer space at all times, and we want to know whether or not they are one of the causes of the formation of ions in the air. We measure this at sea by determining the rate at which ions form in a closed vessel of copper. Then we also measure the amount of radioactive materials such as radium and thorium in the air, for these are another possible cause of ionization.

"On account of the electrical field of the earth, positive ions are continually traveling towards the earth, and negative ions upwards into the air. This gives rise to an actual electrical current between the air and the earth. It is sufficient to neutralize completely the charge of the earth itself in a very short time if there were nothing to renew it. Just what it is that renews it we do not know, although lightning has been suggested as a cause.

"Some of these measurements are rather tedious, as, for example, those of potential gradient. To determine this, observations must be made continually for a full 24 hours, with the apparatus at the stern of the boat. Sometimes the weather is bad, and so it is not at all comfortable, but we relieve each other for a few hours at a time. A complete run of such observations is made only once in two weeks, however. On our trip, this will be supplemented by a continuously recording electrometer attached to the top of one of the masts, far away from the salt spray which so often interrupts our other work.

"FROM such observations as these we have learned some peculiar facts. This potential gradient reaches its maximum at the same time in all parts of the world. It comes at about 18 hours, Greenwich Mean Time, which is the same as 1:00 P.M., eastern standard time. It is at this time that the sun is overhead along the meridian of the north magnetic pole; that is, when it is noon to a person at the magnetic pole, or directly north or south of it. Here again we have evidence of a connection between the electrical and magnetic conditions of the earth, a connection which we want to understand more fully."

With the increasing importance of radio, and developments that have occurred even since the last voyage of the *Carnegie*, Captain Ault has planned to make observations specifically concerned with its problems. Also, the use of radio will add greatly to the comforts of the voyage, for the staff will continually be in a position to receive word from home, and even to listen to American broadcast stations. The transmitting equipment will not be very powerful, as it will have a range of only a few hundred miles. But this will permit communication with passing ships, and also enable instructions to be radioed ahead when approaching a port. Special signals will be sent out from various American and other stations, so that studies can be made of their reception. This will give greater knowledge of the Kennelly-Heaviside layer, the strange conducting blanket that surrounds the earth and so affects radio transmission, perhaps even making it possible.



Courtesy the Carnegie Institution

DUST DETERMINATION

The number of dust particles per cubic centimeter is counted as a daily routine matter

Although the electrical and magnetic observations are more nearly related to the original purpose for which the *Carnegie* was intended, they will form only a part of the researches to be made on this trip. Study of the contour of the ocean bottom will be made by means of the sonic depth-finder. This is the first time that such a device has been used on the *Carnegie*, the Navy having loaned the apparatus.

The principle of the sonic depth-finder, which is rapidly replacing the old methods of throwing a line over-

OSCILLATOR FOR SONIC DEPTH FINDER

The illustration shows the keelson of the Carnegie, *notched out for the part of the sonic depth finder which sends out the impulses which are reflected from the sea bed. See description in text*

board, is that it takes a sound a certain time to travel, reach an obstruction and return to its starting place. In a mountainous country, one can sometimes estimate the distance of a cliff by measuring the time it takes for an echo to return, because the speed of sound in air is known. The speed of sound in water is also known, and it is sent out from the diaphragm of what is really a large telephone receiver. It travels to the bottom of the ocean, is reflected, and then travels back to the ship. There it is picked up by microphones. The difference in time between the sound's leaving and return gives a measure of the depth of the water.

Science Service

AN OBSERVING DOME

Magnetic declination observations are made in a special glassed dome carried amidships

Courtesy The Carnegie Institution

CAPTAIN AULT TESTING THE DIVING HELMET

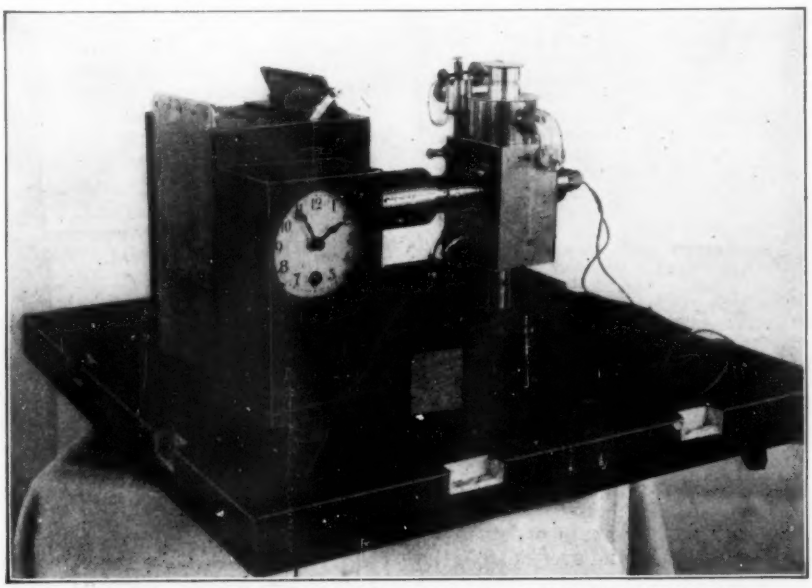
A diving helmet of this simple type enables marine biologists to descend to small depths without delay and without the hampering bulk of the professional diver's expensive accoutrements

To study the composition and temperature of the water at various depths, the ship will heave to every other day, and special water-bottles will be lowered. Thus samples of the water and its contents will be obtained at depths down to as far as 20,000 feet. To handle these water-bottles a new electrically operated winch has been installed on the deck, with the drums made of bronze, so as not to interfere with the magnetic work. A special aluminum bronze cable that in addition to its non-magnetic properties possesses extreme strength as well as lightness, has been imported from Germany for this use. This winch will also be of use to the sailors of the ship in handling the sails.

FOR the first time marine biology will form an important part of the *Carnegie's* work. Specimens of the tiny organisms obtained by the deep soundings will be studied and in addition a pump will continually force water through a sieve to collect interesting specimens. The biologist of the party, if he wishes, will even be able to study the marine life at first hand, at least in shallow water, for a diving helmet capable of use down to 100 feet depth is now part of the equipment.

The last but not the least important part of the *Carnegie's* work will be the study of ocean weather conditions. Admiral Maury, an American naval officer, started the study of ocean meteorology, and his book, "Physical Geography of the Sea," is still a classic. Captain Ault and his associates intend to continue this work with observations of the usual kind, as well as of variations in solar radiation, the importance of which in meteorology has only in recent years been recognized.

The staff of the ship includes seven scientists and 17 seamen. This is larger than before, because of the additional work that is to be undertaken. Not until July, 1931, will they again sail up the Potomac, if all goes well. And with all the preparations that have been made, it seems certain that all will go well, and that the return will mark a great increase in scientific knowledge.



THE ATMOSPHERIC ELECTRIC POTENTIAL GRADIENT RECORDER

This instrument, in a box attached to the top of the Carnegie's *mast, away from effects of spray, will make a continual record of the variations of the electric potential gradient of the atmosphere*

A HERD OF GUERNSEYS, NOTABLE FOR ECONOMIC PRODUCTION OF BUTTERFAT AND HIGH QUALITY MILK

The Economics of Dirt Farming

By FRANK BYERS

MODERN Efficiency Methods. What a vast amount of attention this subject has had in recent years. It is right that it should have. Man began to emerge from barbarism when he started to find better ways of doing things.

When modern methods are applied to agriculture, problems are met which are much more complicated than the problems of industry. Just what and why these problems are can be understood by the construction engineer or the builder who must work exposed to the weather.

AMERICAN industry has achieved its success by efficiency on these points:

1. Improved machinery.
2. Maximum power per worker.
3. Large production per man.
4. Large volume.
5. Standardized product.

The success of these efficiency points is more easily attained and can be more unlimited in industry than in agriculture. For example: consider the building of a tractor and the use of that tractor by a farmer. In the building of the tractor it is possible to use a solid floor for men and machines to stand on; a roof to keep out the rain; proper light and heat. Let sales create the demand and if necessary the tractor plant can run 24 hours a day in all kinds of weather, and every day in the year.

Take one of these tractors out on the farm. It can be run 24 hours a day, but not if it is muddy. A tractor might run in considerable mud, but no farmer would want to work his soil when wet, because a proper seed bed must be prepared with a dry soil.

In industry, machines are applied to steel, wood, and similar materials, which do not materially change their physical condition every time it rains. Soil is not only composed of the elements of plant food, but also is the home of a host of living bacteria, friends of the farmer. These organisms must be treated with respect. They must have air to multiply and carry on their numerous enterprises. Decomposing organic matter, securing nitrogen from the air in the case of leguminous plants, rendering the elements of the soil available to the tiny plant roots in a soluble form—this is the work of the various soil bacteria. To cultivate the soil when too wet, means the death of these necessary bacteria, for unless the soil is worked when dry, it packs and bakes into a hard air-excluding mass.

THEREFORE, a farmer could be equipped with the latest and most efficient power machinery, but he could not use it until the soil conditions were right, and if a season should be

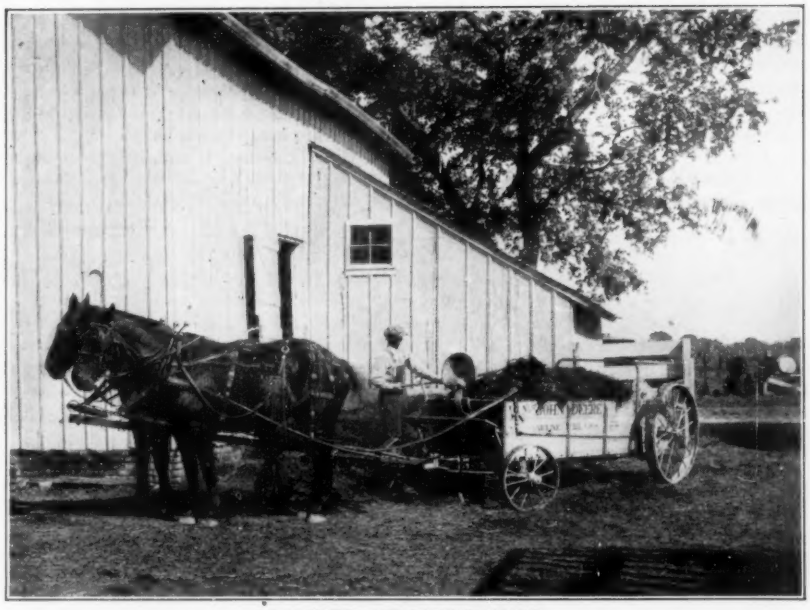
Aid For the Farmer!

JUST as surely as day follows night, farm-aid bills frequently appear before Congress and are discussed pro and con. The reports of the progress of these bills often are featured in the daily press, but the average reader knows little of the conditions which make aid a serious economical consideration.

The author of the article which we present on these pages is an experienced farm manager, and we believe that our readers will agree with us that he presents the economics of the farm in a most comprehensive manner, and throws a revealing light on the difficulties which beset the agriculturist.—*The Editor.*

one of continuous rain, he could do nothing. While the farmer waited for it to quit raining, the manufacturer of tractors could be busy every day, utilizing his power machinery and labor to build more tractors, increasing his output per man and decreasing his cost per unit.

This comparison also brings out another point, which is this, that economically a farmer gains nothing by saving time, if he cannot use that time on some productive work. The element of time is very important in some farm operations. The planting of corn and other crops, the harvesting of leguminous hays and grain, all need to be rushed to completion to avoid loss, and in these operations, modern farm machinery has effected its greatest economy.



A SAVER OF MAN POWER

This manure spreader automatically unloads by horse power, saves the man power formerly required for unloading, and distributes the manure evenly over the soil, insuring better crops

THE United States Department of Agriculture reports that since 1889, the efficiency of the agricultural worker has increased more rapidly than the efficiency of the factory worker. There are exceptional examples of efficiency in industry, where inventions and machines have greatly increased the output per worker. These outstanding successes have been chiefly where iron and steel are fabricated. Industry cannot claim any great efficiency in the building trades, for here, as in agriculture, machines are difficult to apply and much hand labor is necessary. In crop production, it is difficult to have set rules of procedure. Suppose that we are in the midst of our first alfalfa hay harvest. Just when is alfalfa properly cured and ready to be put in the barn? Shall we cut today, rake tomorrow and haul in the third or fourth day? That will depend upon the rankness of growth, the moisture in the air and soil, the brightness of the sun and the presence of wind. All of these things influence rapidity of drying, and all of these influences vary in degree in June, July, and August, in which months our three crops of alfalfa are harvested. Alfalfa is cured when it is cured, and the farmer knows when it is cured by lifting it and by feeling and looking at it.

Farm cost accounting cannot be standardized in every case. For example, the crediting of manure produced by live stock to that live stock and the charging of the manure to the crop upon which it is applied requires the consideration of these questions. First, different crops respond to manure and are benefited by it in different degrees. Second, the fertilizing value of manure is not all taken up by the crop the first year, and succeeding crops on that land receive some benefit for several years. Considering these points, what value is to be placed on a ton of manure and what percent of the charge should be against the first year's crop? If manure is applied to the land and the crop is a failure, can the livestock be given any credit?

Increased efficiency pays the individual farmer well. The total cost of growing an acre of corn remains fairly constant regardless of the yield. It costs the same to grow an acre of poor corn as an acre of good corn. Therefore yield per acre is important, as an influence over profit and cost per bushel.

A MODERN POWER PLOWING OUTFIT

This type of plow will work from 10 to 15 acres per day, depending on soil conditions, and thus will do the work of two or three men and from nine to 15 horses, reducing labor costs materially

THE large tractor plow has been the means of reducing labor costs on field work. In this implement, one man has at his command 20 to 40 horsepower. The saving in labor that can be made by larger plows is shown below.

One Man Using Different Sized Plows

Number of Bottoms	Power Used	Acres Plowed	Total Cost per acre	Labor Cost per acre
One	Two horses	2¼	$3.20	$1.78
Two	Five horses	Five	2.38	.80
Three	Tractor	Nine	1.62	.44

In industry there is 4.5 mechanical horsepower used per worker, while in agriculture, there is about three horsepower per worker. However, in the use of mechanical horsepower, the farmer is at a great disadvantage, for the simple reason that during the

winter months his shop is closed and he cannot use his power. The result is that the farmer's use of mechanical horsepower per average month is very low.

The difficulty of continuous productive operation is a great barrier to farm efficiency. It is hard to keep machines, horses and tractors busy, for

AGRICULTURAL MACHINES
1. Movable.
2. Exposed to Weather.
3. Insecure Footing.
4. Material Irregular.
5. Conditions Varied.
6. Minimum Hours Used.
7. Area Extensive.
8. Supervision Difficult.
9. Piece Work Impossible.

A COMBINED CUTTING AND THRESHING MACHINE

This machine will cut and thresh from 20 to 60 acres of grain a day, depending on size. Two men can operate it, and it is said to be the greatest labor saving machine yet given to agriculture. Twenty men are needed to operate a machine which accomplishes threshing only

when one piece of work is completed, another must be started. Growing a bushel of corn calls for many different operations: plowing, disking, harrowing, planting, cultivating, harvesting with corn binder or corn picker, and finally storing or marketing. For each of these operations a different machine is used, with horses or tractor as the power. Most farm machines are used only a few days each year and since one of the rules of shop practice is "more hours used means greater efficiency" a difficult problem is ever present. The efficiency and durability of the tractor is nearing perfection. On field work it is greatly reducing labor costs, but for drawing loads, its usefulness is limited by mud and rough frozen ground, and also by available farm work of this kind to be done.

SOME of the ways in which agricultural machines differ from industrial machines in actual operation are listed as follows:

INDUSTRIAL MACHINES
1. Stationary.
2. Under Cover.
3. On Solid Foundation.
4. Material Uniform.
5. Conditions Uniform.
6. Maximum Hours Used.
7. Area Limited.
8. Supervison Easy.
9. Piece Work Possible.

Farm cost studies show that as a rule production is more economical on large farms than small. However, there is a limit to how large the farm can be. The farming of very large farms as a unit has been only partially successful, especially in the middle west. There have been some very successful large wheat farms in the northwest, but since the one-crop farm is economically and scientifically unsound, these successes must be rather temporary.

LARGE, level fields are best adapted to large power machines. It is not always possible to find hundreds or thousands of acres that are level and unbroken by hills and swamps. If the large power unit can start out in the morning and run all day it accomplishes much, but if the work is to be done in a distant field, then much time is lost going there and back.

If the large farm is divided into smaller units then we are back to the small farm again, but with some added efficiency through better management.

Farm tractors and machinery travel very slowly, although in recent years implement manufacturers have greatly increased the speed of tractors moving idle. Small fields require much turning, and turns must be made with the machine idle.

It would be possible to farm efficiently a very large level acreage, considering only the preparation and planting of crops. The growing of large and profitable crops, however, brings us into the questions of soil fertility and crop rotation. The soil is not an inexhaustible bank from which yearly supplies of plant food may be drawn, without an accounting sooner or later, and it is usually sooner. At an Illinois station, which has the oldest experimental plots in the United States, where corn has been grown continuously for 50 years on the same ground without soil treatment, the yield is less than 25 bushels per acre, while corn grown with soil treatment in a rotation of corn, oats, and legumes has yielded 70 bushels per acre.

A three or four-year rotation has some advantage in that it distributes the labor over the season. It also requires that the acreage be divided into the three or more parts according to the rotation. To divide the land into smaller parts, each with its different crop, requiring to considerable extent different methods and machines, is contrary to modern factory procedure, which aims to combine and unify, rather than to divide and vary.

THE application of manure, while not absolutely necessary, is highly desirable, and this requires the keeping of livestock which has its complications in labor, buildings, reproduction, and last, but most important, market selling price. It is very easy to feed all the crops from a farm into livestock and lose any profit that might have been secured by selling the crops. This, of course, depends upon the relative market value of crops and livestock and also upon the farmer's cost of growing those crops, but it is impossible for even efficient crop production to cover up the loss sustained by a low price for the final livestock product. Industry figures its costs and decides what the selling price of the finished product should be. The farmer can figure his costs of production, but he cannot establish his selling price. The selling price of most farm products is named by the buyer.

"The eye of the master fatteneth his cattle," is just as true now as it was when written, and in milk production, beef production, and all other livestock enterprises, there is an element of love of work which is essential to success. To carry out the latest and best methods of feeding and care may not be enough. Every employer knows that personal interest cannot always be bought. In reproduction and inheritance we have elements of chance and variation, which are absent from industry.

It would be possible to operate efficiently a large grain farm of a thousand acres or more without the use of livestock. Such a farm should be all level land to provide large fields for the

operation of large power units. The fertility of this farm could be maintained by plowing under legumes, and applying the proper fertilizer. The individual small farmer cannot afford to own some of the large labor-saving machines, because he cannot use them enough, but the large farm could afford to own them.

The large grain farm presents difficulties, viz:—continuous use of labor, efficient labor, maintenance of fertility, and advantageous marketing, but it does offer great opportunity for the efficient use of labor-saving machines.

The manufacturer given his efficient machine can turn out a perfect product. To increase the volume of his product, he needs only to operate more of his efficient machines. How different it is in agriculture.

Consider the humble cow; without her milk, your children and mine would be small, just as are the Japanese. The dairyman may have one cow in his herd that is a very efficient and profitable milk-producing machine. According to the laws of heredity, the heifer calf from this cow should grow to be an efficient milk producer, as was her mother. But alas, this proves true only about 50 percent of the time. This calf when mature, may not give enough milk to pay for the feed alone.

THE breeder can influence and aim toward perfection, but the blood of every individual carries the characteristics of a thousand ancestors good and bad, which may crop up in offspring.

Since milk production is built on maternity, a 100 percent crop of bull calves is a fly in the ointment. It takes from two to two and a half years for our promising heifer calf to grow into maturity and start producing milk and until then, the value of this animal is an unknown quantity, so far as economical milk production is concerned. The cow does not give milk until she has a calf, as most readers know on second thought.

Where in industry is the machine, the economic value of which is not proved until two years after the machine is created? There are none outside the experimental rooms, or should not be. The cow which proves to be unprofitable as a producer of milk, is sold for beef, and returns about one third the cost of raising; the balance is a loss.

The milking machine is being perfected. It has been on the way for some 20 years. Why has it taken this long? Simply because in the milking machine, we have the application of a machine to a live animal. What machine in industry requires the cooperation of a dumb animal for successful operation? A cow is not a cow when a milking machine is put on her. Cows are just as different in disposition as humans, and one bossy will give down her milk freely to the machine, while her stall mate may refuse to let down a drop. However, the milking machine is making progress as a labor saver. On one farm managed by the writer, the hours spent daily on the dairy herd was reduced by four with the installation of a milking machine.

LARGE volume, which is an efficiency factor in industry, meets with a stumbling block in nearly all livestock enterprises in various diseases, which seem to cause greater losses in large herds than where only a few animals are kept. The crowding of livestock encourages the spread of disease. Where large numbers of livestock are desired it is advisable to divide into small units. Hogs and poultry become diseased in old yards, and it is necessary to move to fresh clean ground.

In industry, quantity production is the method by which raw materials can be transformed into salable goods in the least possible time. The shorter the time, the lower the costs. Continuous operation and movement makes this possible. But in agriculture, the transformation of plant food into finished crops is a process requiring months of time and in most cases there is but one turnover in 12 months. In pork production, there can be two crops of finished pigs per year, and in beef production, one in 12 to 24 months.

That increased efficiency will pay the individual farmer well is very evident from the results obtained in farm cost accounting work, carried on by the Agricultural Experiment Stations. That a general increase in efficiency on all the farms of the country would result in a greater surplus and call for improvement in merchandising methods is also true.

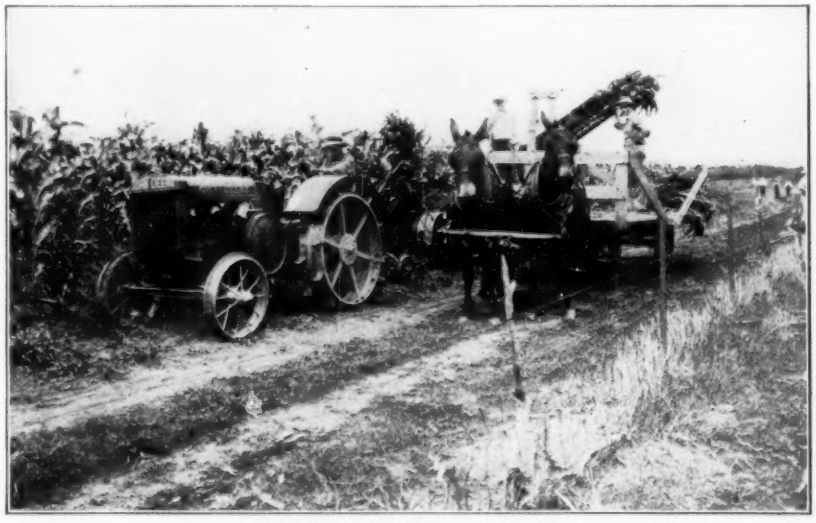
The one-horse hillside farm, which will probably always be with us as a losing business enterprise, is largely responsible for the disastrous surplus. These small infertile tracts are not adaptable to power or large scale production, yet upon them some farmer is content to scratch out a meager existence. To this class could be added some ill-advised swamp reclamation projects and millions of acres that would be more profitable if timber were grown on them.

FARMING is a business in which the many problems must fall upon the shoulders of one man. The farmer must have knowledge of crop production, livestock, buying, selling, and all their related sciences. He must be his own carpenter, machinist, gas engine expert, plumber, electrician and bookkeeper. Specialization, which has been such an aid to industrial efficiency, is difficult to accomplish on the farm.

The farmer can improve himself, his farm and his financial condition by the study and application of the following subjects:

1. Farm Cost Accounting.
2. Soil Fertility.
3. Soil Drainage.
4. Improved Seeds.
5. Improved Live Stock.
6. Better Marketing.
7. Sanitation.
8. Scientific Feeding.
9. Labor Saving Machinery.
10. Better Homes.

That the farmer can and will become more efficient, there is no doubt, but until a way is found to control the weather, the farmer will always take that risk in his work. Improved machines and methods will accomplish wonders in future years.



CUTTING AND BINDING CORN

The corn binder cuts, elevates the corn to the wagon, and binds it

Fairchild Aerial Surveys, Inc.

THE SCENE OF THE ACTION

The approach is laid, the shore abutments in place, the western pier finished—all waiting for a little gang of workmen doing some mysterious job in the middle of the Hudson River. When they finish they will have left behind them a monument to ingenuity and patience

The Caisson Slipped

Righting a Bridge Pillar Foundation Is One of the Hardest Tasks Engineers Ever Attempted—and Accomplished

By LLOYD LLEWELLYN

IMAGINE a building 60 feet wide, 136 feet deep, and eight stories high. Conceive of this building not as composed of a lot of rooms but as a solid block of concrete weighing about 16,000 tons. Picture it sunk deep in mud and tipping over at an angle of 45 degrees. Now, to make it still more complicated, suppose that the whole building, except one tiny corner of the roof, is submerged under a deep, fast-moving river.

Imagine that it is your task to pull that ponderous structure, having an under-water weight of 12,000 tons, back to the perpendicular.

Such is the job in the Hudson River at Poughkeepsie upon which engineers have been working since July, 1927. It constitutes one of the most difficult feats of corrective work known to the history of engineering. Compared to it, righting the Tower of Pisa would seem like child's play, for all of the work in the Hudson must be done by divers, much of the time in water so muddy that they cannot see what they are doing but must feel their way.

At Poughkeepsie, just south of the famous structure which is said to be the second highest railroad bridge in the world, the State of New York is preparing to throw across the river a mighty span over which vehicles and pedestrians may travel from one shore to the other. When completed it will be known as the Mid-Hudson Bridge. The original estimated cost of the completed structure was 5,500,000 dollars, a cost which probably will be exceeded by several hundred thousand dollars. Originally it was intended that the bridge would be open for traffic by January 1, 1929, a date which already has been postponed a year.

THE engineers in charge of this work are Modjeski and Moran, reporting to Colonel Frederick S. Greene, Superintendent of Public Works for the State of New York, with Clarence W. Hanson in direct charge on the job for Modjeski and Moran. Mr. James M. Bixby, Division Engineer, and L. S. Hurlburd represent Colonel Greene on the work. The contractor is the Blakeslee Rollins Corporation of Boston, Massachusetts, and is represented by J. W. Rollins, vice president, and Ray J. Reigeluth, while Walter G. Cheever is the superintendent in direct charge on the work. Nearly half of Cheever's 35 years have been spent with this one company doing engineering jobs which would have made Cheops or Hiram Abif gasp with incredulity at their difficulty.

Nothing is more important in a suspension bridge than the pillars whose bases rest far below the bed of the river and from whose tops, towering high in the air, are swung the steel cables from which the causeway is hung.

Work on the two caissons began April 1, 1927, and for some time proceeded uneventfully. Each of these caissons was a huge steel shell 136 feet long and 60 feet wide, with the ends rounded, making it a sort of huge steel scow. Technically each huge steel rim was called a cutting edge. Concrete walls divided it into cells or sections, each one of which had a false bottom so that the entire steel shell formed a wall or hull which was towed easily from the yards at Staten Island, where it was made, up the river to Poughkeepsie.

At Poughkeepsie concrete was poured into each of the 25 pockets in each caisson until it was almost heavy enough for sinking into position; then it was towed to its proper place in the river and anchored broadside to the shore. More concrete was poured into each of the sections, the added weight causing the caisson to sink. Wooden forms were built up on top of the

caisson to a height of about 20 feet. More concrete was poured in, the caisson sinking deeper and deeper down through the bottom of the river, so that eventually it would rest on hardpan or rock.

The river bottom is uneven. Little difficulty was presented in the sinking of the western caisson where the water is 60 feet deep, with a layer of sand and mud about 35 feet below that and hard rock below the mud. All the work on this structure was completed by the middle of May, 1928; although according to the schedule, it was to be the later of the two to reach completion.

THE eastern caisson presented a more difficult task. Below the river bottom was a thick strata of treacherous, rubbery clay of uneven thickness with a rock bed 60 feet deeper than the bed nearer the wester shore. Work on the easternmost caisson had proceeded without mishap until the concrete structure had penetrated to a depth of about 70 feet below the surface of the river—10 feet into the mud.

Suddenly, on July 27, 1927, the huge caisson slipped. The eastern edge of its bottom sank quickly through the mud, tilting the whole structure sharply to the east, and coming to rest only when it had careened to an angle of 45 degrees from the perpendicular.

Here was real trouble. Approximately 250,000 dollars had been spent on this caisson and it had slid dangerously, almost hopelessly, from its proper position. It was too big to be destroyed and replaced by another, because it was in the spot where any new caisson would have to be sunk, and the enormous task of destroying the present unfinished caisson would so wreck the river bed that no other pier could be erected on the immediate spot. And no other spot would do, because not only was the western pier nearing completion but the abutments on shore to which the cables were to be anchored had been finished months before. Under the circumstances, the only thing to do was to bring the sunken, tilted caisson back to the perpendicular. A task of that nature, of such size and presenting such handicaps, probably never had been attempted. There were no precedents by which to be guided.

The first thing attempted was the tying of four pontoons to the submerged eastern edge of the top of the sunken structure. Their total lifting force of 400 tons had no more apparent effect than the flipping of the fin of the tiniest minnow which swam around the mountain of concrete and steel that had invaded his home.

THE TILTED CAISSON

After the slip. The steel superstructure for purpose of pouring concrete was still in place

FEARS were entertained that the sucking effect of the mud would seriously interfere with the work of correction, and to disintegrate it 100 sticks of dynamite were planted in the river bed. When they exploded the only appreciable effect was to break the fastenings of the pontoons.

Would the caisson settle still more? This was something that must be taken care of before the work of bringing it back to position could proceed. To compact the mud, 6000 cubic yards of crushed stone and gravel were dumped on the river bottom adjacent to the east side of the caisson. Some attempt was made to compact this gravel by ramming it with a pneumatically driven hammer. It had little more solidifying effect than would the pushing of a toothpick into a pile of sand.

Next, huge wooden cribs, each filled with 200 tons of crushed stone, were hung from the top corner jutting out of the water, the cribs themselves being at a point sufficiently far down to be below the center of gravity of the caisson. The purpose of this was to exercise a push against the caisson's western side. Then a start was made to build covers on four of the east pockets so that the air therein could be removed. After several weeks of preparation, this plan was abandoned. The next step was to build a cofferdam with the idea of pumping the water out of the caisson, but this idea was abandoned before the cofferdam was completed.

NONE of these efforts, however, showed any reaction whatever. Late in December ice in the river seriously handicapped the work and no real progress was to be expected until weather conditions became more favorable. It was not until March 15 that the ice finally went out and work was resumed.

A deep trench was then dug out on the west side of the caisson. Then divers began jetting. In this operation a jet of water under high pressure is played against the mud to wash it away. Two jets were used, operated by electrical pumps, each of them having 150 pounds pressure at the pump, which meant about 125 pounds pressure at the nozzle. One delivered 1250 gallons per minute and the other 2500 gallons per minute. In this way, mud in the center pockets was washed out and deposited in the trench.

Next drag buckets dragged the mud

JUST BEFORE THE SLIP

This snapshot was taken the day before the accident. The height above the water is indicated by the barge's smokestack in the foreground

WHEN HOPE WAS LOWEST

With so little above the water and so much in the mud below the river bottom, prospects of righting the careened structure seemed almost nil

SLOWLY THE CAISSON MOVES

Surrounded by floats and booms with weights in suspension exercising constant strains, the big caisson began to move after ten months' effort, at first only two inches a day being recorded

from the bottom of all the pockets on the northwest, west, and southwest sides of the caisson.

During the autumn, before ice formed in the river, six cribs, each of them holding 200 tons, had been sunk in the river and hitches made with blocks and falls over gallows frames set up on railroad car floats. These weights, in constant suspension, were for the purpose of exercising a constant strain against the settling of the caisson.

TEN 70-foot booms of 18 by 18-inch timber were placed at right angles to the upper side of the caisson and from each of these booms a 50-ton weight was hung.

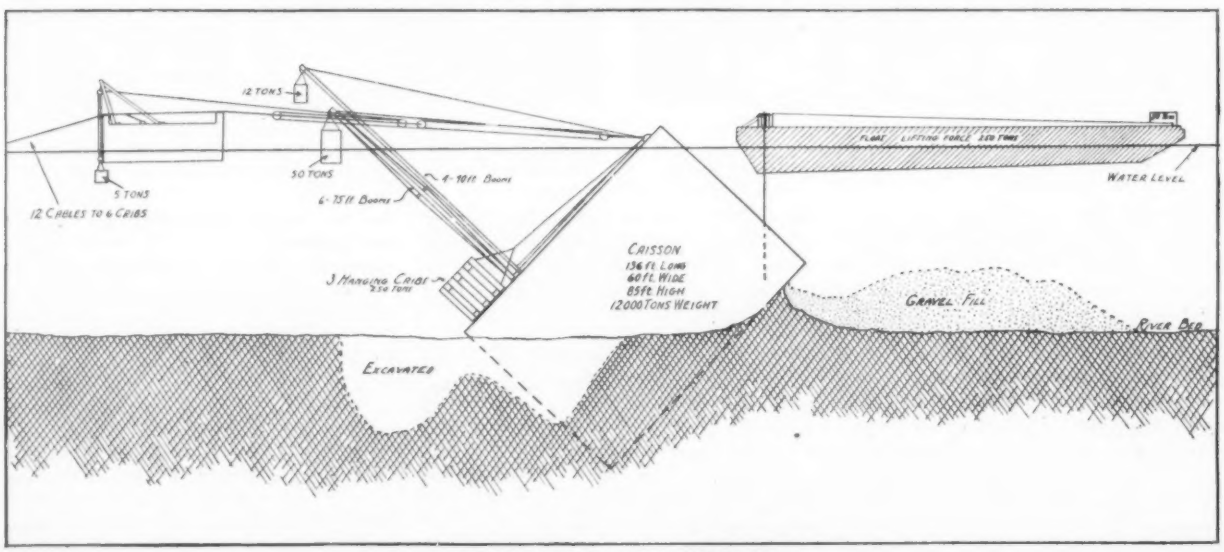
With all these contrivances calculated to let the force of gravity pull the structure back into position, additional efforts were necessary to move some of the structure in the mud and some of the weight in the form of concrete itself. Immense drag-line buckets were carried down, each of them looking like some giant horse-shoe crab, to pull out the mud and rubble which collected in the pockets. Excavations were made in the concrete to dig out the mud from under the upper corner of the bottom.

Early in May, the structure began to move, the first perceptible movement being on May 7. For some time, although the force was working 24 hours a day, a movement of only about two inches a day was made. This progress, however, was satisfactory. More and more the structure was pulled up towards the perpendicular and, as time went on, progress was faster. By July 10th the caisson had been pulled back a total distance of about 30 feet. The structure was now at a point were the top corner had passed the center of gravity and gravity was working with the engineers instead of against them. From then on progress was comparatively rapid, sometimes a movement of as much as two feet in 24 hours being effected. Steadily, surely, the giant caisson was pulled back towards the perpendicular so that once again the concrete might be poured in and the cutting edges once more begin sinking straight down through the river bottom to bed-rock as the work on the bridge proceeded.

The progress of the work has been measured by triangulation. A rock about 100 feet high is on the eastern shore of the river nearly opposite the caisson. On top of this a man was posted with a surveyor's transit. He trained his instrument on a fixed point on the shore and on another fixed point on the small edge of the caisson visible above the water.

THE slightest variation in the angle of the two lines gave him the data he needed for registering any movement, even to the fraction of an inch. Beside him stood a large wooden board with the face of a clock painted on it. The circumference measured 12 feet. One of the two moving hands, painted black, recorded progress in feet. This corresponded to the hour hand of the clock. The other hand, painted red, corresponding to the minute hand, recorded inches. As progress was noted, the watcher moved the hands of the clock forward to inform the workers out in the river of the progress they had made.

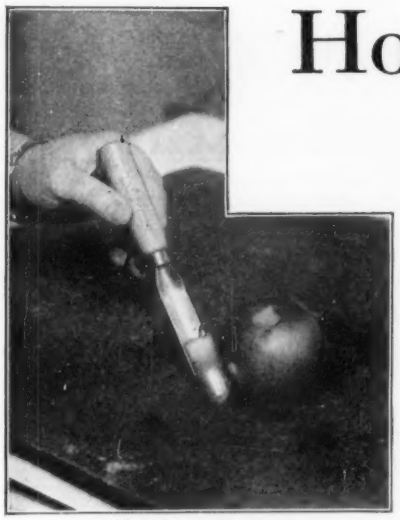
Months had been lost by the catastrophe. Two hundred thousand dollars had been spent in setting the concrete pile aright again. The public would have to use ferry-boats for a year longer than had originally been expected, instead of motoring rapidly across the broad Hudson by January 1, 1929. But the engineers rejoiced. They saw themselves accomplishing successfully one of the most difficult feats of corrective engineering ever attempted in the age-long effort of man to conquer Nature.



HOW IT WAS ACCOMPLISHED

The three hanging cribs, the cranes and the barges all helped; after the caisson was drawn back to a position where gravity acting directly on the caisson was working with them instead of against them, daily progress began to be measured in feet instead of in scant inches

Household Inventions

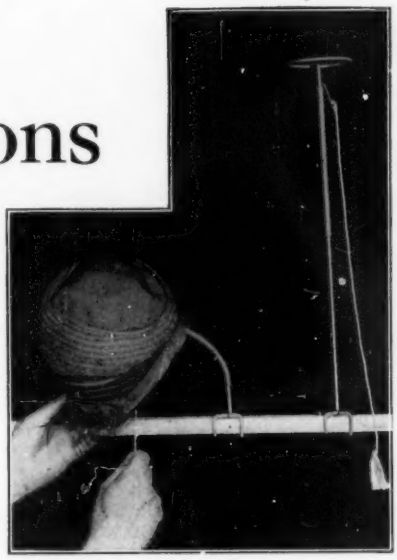


APPLE CORER

Too often apple corers are made of cheap metal and the cutter is curved so that it does not withdraw the core. This new corer from England is of finely tempered steel and has a circular cutting edge that brings out the core when cut.—*Lewis and Conger, 46th St. at Sixth Ave., New York*

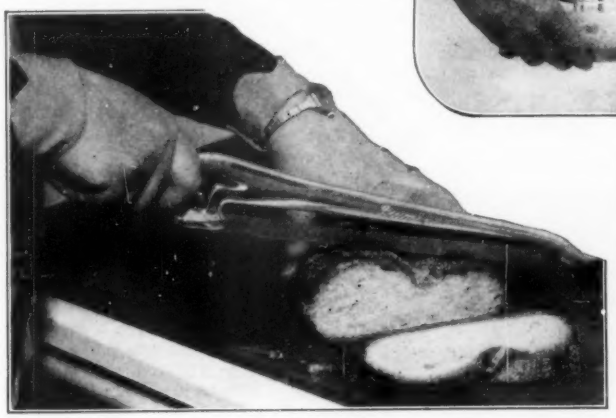
OUT-OF-THE-WAY RACK ➤

This new rack for women's hats utilizes the waste space near the ceiling of the wardrobe. It consists of a metal form on the top end of a metal rod which is mounted on a spiral spring. When a hat is placed on the form, the whole springs back to an upright position. Rack is pulled down by a cord.—*Economy System Co., 258 W. 28th St., New York*



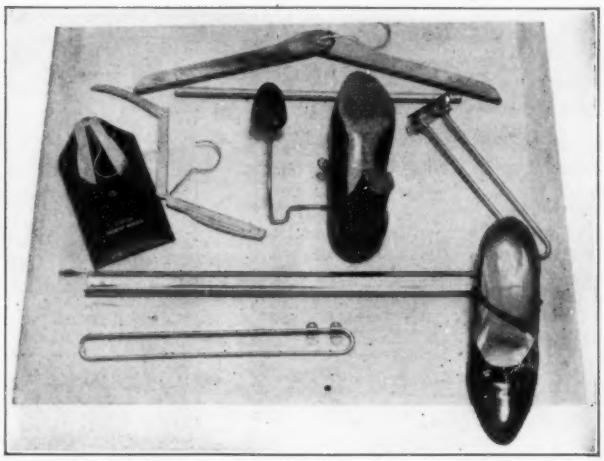
WATER POWER BEATER ➤

This simple device eliminates much of the tedium of the kitchen and does a better job of beating eggs, cream, et cetera, than the ordinary hand beater. When connected to a faucet, and the water turned on, the beater does all the work in a few minutes. A distinctive feature of this new water power beater is that the water turbine housing is small, and a large cooking vessel may easily be placed underneath.—*Lewis and Conger, 46th Street at Sixth Ave., New York*



BREAD SAW

Many bread knives are made with saw teeth and most of them are efficient enough for cutting ordinary bread, but this new one is in all reality a saw. It is almost exactly the same as the hack saw commonly used in machine operations, but the frame is much nearer the blade and is thinned into a wedge so that it will "follow through." It is especially adapted to the job of cutting fresh, soft bread and is said to work more rapidly and do a better job than most bread knives now on the market.—*Lewis and Conger, 46th St. at Sixth Ave., New York*



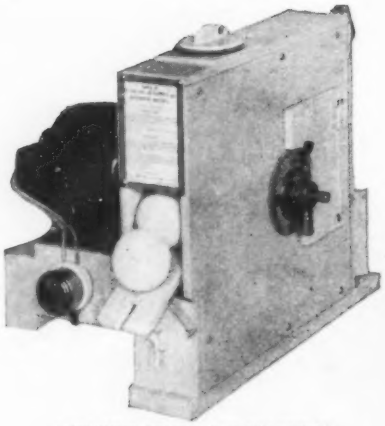
CLOSET ASSORTMENT ➤

A selection of hangers and racks which costs but 80 cents. At the top is a clothes hanger, the shoulder arms of which fold down against the trouser rod; at the left below is a hanger that folds compactly for carrying in the envelope; in center is a shoe rack made of nickel-plated steel tipped with a wooden toe and so bent that when screwed to the wall, the toes hold shoes as shown; and at the right is a loop upon which hangers may be hung. Below is a metal strip which holds shoes by the heel, and at the bottom is a loop for attaching under a closet shelf.—*F. W. Woolworth Company.*

SCISSORS SHARPENER ➤

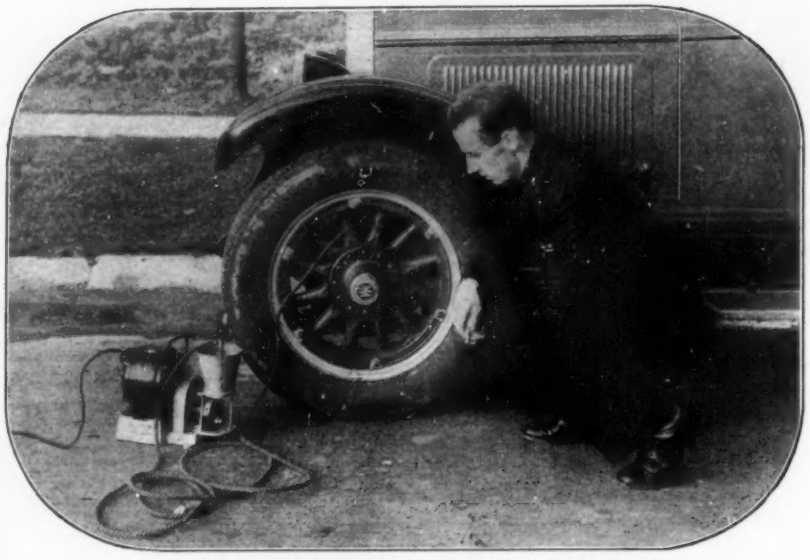
The average sharpener for scissors is quickly dulled past satisfactory use or perhaps it is too small for safety. This new one imported from England is made of fine steel and has a handle large enough to eliminate the danger of cutting the hands when the device is being used.—*Lewis and Conger, 46th St. at Sixth Ave., New York*

Inventions
New and Interesting



TENNIS BALL RE-NAPPER

Tennis balls that have been used until the nap is worn so that they "sail," out of control, may be quickly re-napped and whitened with this machine. They are then as good as new unless already "dead".—*Tennis Ball Renapping Machine Company, 52 California Street, San Francisco*



PORTABLE MOTOR-DRIVEN AIR PUMP

This complete unit, weighing only 40 pounds and easily moved from place to place by hand, has a displacement of one and one half cubic feet per minute and will deliver compressed air at pressures up to 75 pounds. Attached to any electric light socket or base plug, it can be used to pump tires, blow out gas lines, for spray-painting, et cetera.—*Demco, Inc., 105 S. Calvert St., Baltimore*

▲ NECKWEAR PRESSER ▼

A new press to take the wrinkles out of neckties. Ties are inserted between the covers of the book in which there is a heating element; they are then dampened, the covers are closed and clamped tightly, and the cord attached to a light socket. After the current has been turned on for about five minutes, the tie is removed. The device presses the lining as well as the surface. —*Hare Mfg. Co., 600 S. Delaware Ave., Philadelphia*

BOOK LIGHT ➤

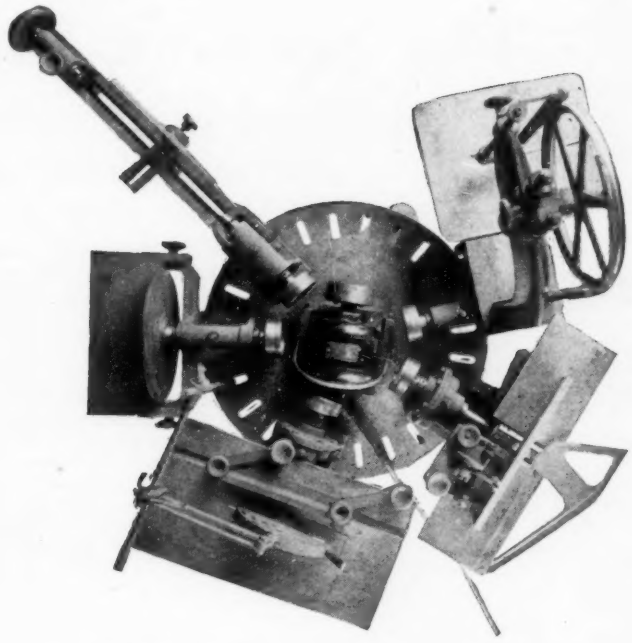
Many people find a bed clamp light inconvenient and unsatisfactory. This new light is unique in that it clamps directly to the book and gives a satisfactory light on the printed page for the person who likes to read in bed or some out of the way corner. It can be connected to any standard light socket, and is said to give just the right intensity of light.—*Melodelite Corporation, 132 Nassau Street, New York*

UNIQUE "SCYTHE" ➤

The device illustrated is but one of several models of a scythe built somewhat on the principle of the golf club. The person using it stands erect and, with a light swinging motion can trim the edges of lawns or chop weeds with little effort. It is light and serviceable, and the cutting blade is double-edged so that it will cut with either a forward or backward stroke. Other models (not shown) have only one leg which terminates in a bent, double-edged cutting blade.—*The Village Blacksmith Folks, Watertown, Wisconsin*

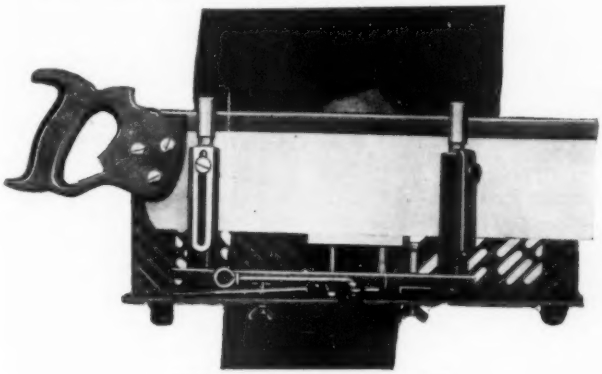
PLIER WRENCH

Made of high quality steel, forged and specially treated, this new plier wrench is equipped with jaws that are made to fit hexagonal nuts in a large range of sizes. It may also be used on square nuts and on pipe. It has good leverage and will grip the job without chewing off the corners. For quick work, it takes the place of a ratchet wrench. It is readily adaptable to all sorts of rapid work, especially that of battery men.—*Bear Mfg. Company, Rock Island, Ills.*



▲ WOOD-WORKING MACHINE

This machine is a composite of wood-working units, all cleverly arranged on a circular steel table to conserve space. This photograph was taken from above to show, from upper right in a clockwise direction, the band saw, the jointer, the rip saw, the sander, and the lathe. One centrally located electric motor, which can be connected to an electric socket, drives any one of the units by means of a multiple fingered machine clutch.—*The Utility Machine Co., Cleveland, Ohio*



COLLAPSIBLE MITER BOX

For the workman who must follow his job from place to place, this new miter box fills a long felt need. It folds compactly so that it may be packed away among other tools without taking too much space. On the job, it is adjustable by means of the wing nuts and the screws illustrated here.—*Goodell Pratt Company, Greenfield, Mass.*

WOOD CARRIER ➤

It's a simple matter to carry a heavy load of wood to one's fireplace with this flexible, light-weight leather carrier. It is made of well-tanned cowhide attractively studded with copper rivets.—*Home and Campcraft Co., Plimpton Building, Hartford, Connecticut*

ASSORTMENTS OF TOYS FOR CHILDREN WHILE TRAVELING

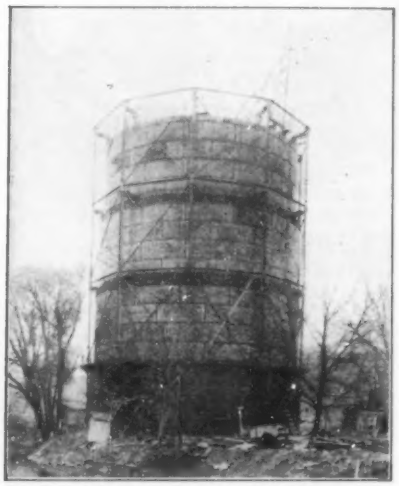
At the left is shown an assortment of toys selected for the child of four to six years of age. They are suitable for a railroad journey since everything is noiseless and requires little space. At the right is shown a group suitable for the child of six to eight years of age, and adapted to use on board ship.—*R. H. Macy Company, New York*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

All Welded Gas Holder

THERE has just been completed at Albion, Michigan, the largest all electric-arc-welded low-pressure gas holder ever built. The construction and design are both the work of the Western Gas Construction Company of Fort Wayne, Indiana. The holder with all lifts elevated to their maximum height stands 113 feet seven inches above the foundation. It has a diameter of 74 feet and weighs 516,385 pounds plus the weight of the welding rod that was used. The gas holder has a capacity of 300,000 cubic feet of gas at a water pressure, when full, of 12 inches.



This huge gas holder with a capacity of 300,000 cubic feet of gas, is the largest ever built entirely by an electric arc welding process

Building a gas holder by electric arc welding has inherent practical advantages that recommend it strongly. It simplifies construction and reduces fabricating cost. When a gas holder is made of riveted plates it is necessary to employ the tank shop to lay out and punch all the members. When electric arc welding is used it is only necessary to lay out and punch the members in the shop for fitting-up bolts. The plates are, of course, rolled to the proper radii in the shops. On this job the plates were assembled in position with bolts, and tack welded, with the exception of the cups and grips, which were fabricated in the shops, assembled in sections on the ground, and welded in place.

On this gas holder four tons of welding rod were used. If a holder of the same size were made of riveted construction seven and one half tons of rivets would be necessary. Four welders manufactured by The Lincoln Electric Company, Cleveland, Ohio, placed 21,414 lineal feet of welding. The entire job was carried through almost without a hitch and with much less difficulty than would naturally be expected with a new structural process.

Radium Rays Test Flaws in Castings

USING radium rays so penetrating that they can go through pieces of 15-inch metal to test for hidden flaws in large castings, is one of the latest accomplishments of the Russian State Radium Institute, Leningrad.

These "gamma rays," as they are called, are similar to X rays, but are of much shorter wavelength. They are more penetrating and can pass through pieces of metal too thick to be examined with the X rays. Examination by radium is said also to be cheaper than with X rays, because the same radium can be used over and over for an indefinite time.

Large and expensive photographic plates are not required, since the rays, after passing through the object, act upon a special, sensitive electroscope. The test record is preserved for future reference in the form of a simple diagram automatically traced. Another advantage is that gamma rays speed up the inspection—it may be cut down to a couple of minutes for a large casting—while X rays require a very long exposure, often of several hours, when metal is more than two or three inches thick.

The apparatus, as developed by the Russian scientists, is very simply constructed. A tiny glass capsule with a radium preparation is inserted into a deep hole bored in a large lead ingot. This ingot stops all rays, except a narrow strong beam that goes along the bore. This beam pierces the casting and encounters two filaments charged with electricity and enclosed within a copper cage. There is an air space between the filaments and the cage which acts normally as a perfect insulator, allowing no electric current to pass through it. But as soon as gamma rays have a chance to get in the cage they ionize the air and turn it into a conductor.

Electricity from a battery flows from the filaments to the copper cage and from it passes through a galvanometer and back to the battery.

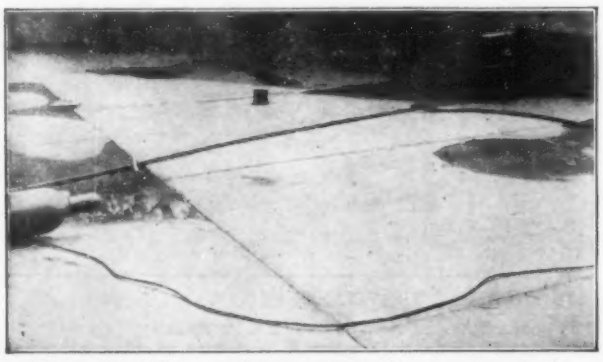
As the intensity of the rays changes with the thickness of metal pierced by them, the rate of ionization varies accordingly. Therefore the flow of electric current exactly mirrors the shape of the object under test. Any deviation at once shows that some imperfection is present.—*Science Service.*

First German Pulverized Fuel Locomotive

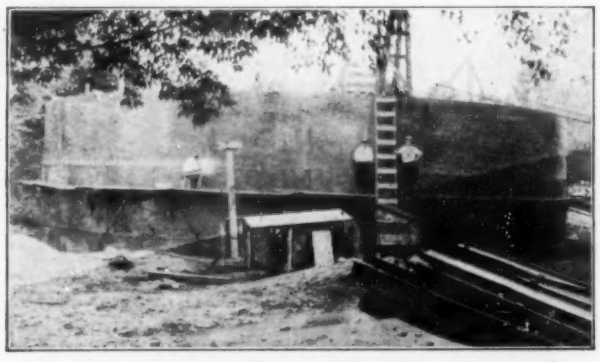
PREVIOUS endeavors to design pulverized coal locomotives have met with considerable difficulties, owing to the limited amount of space available. However, a new engine developed by the AEG Company, of Berlin, has given excellent results in actual operation, particularly in connection with pulverized lignite.

Preliminary tests had made possible the raising of locomotive boiler efficiency from 52 percent with normal firing to 67.5 percent with pulverized fuel, and with an hourly load on the heating surface of 70 kilograms per square meter of surface. Difficulties associated with combustion and the production of slag were overcome by the use of convenient nozzles for breaking up the pulverized fuel.

Outwardly, the new locomotive does not present any distinctive features, except for the peculiar design of the tender, which is entirely enclosed and, in the place of a coal bunker, comprises a horizontal cylindrical tank measuring about six feet, six



The finished floor of the gas holder. The neatness of the welded seams and the absence of rivets will be noted



As the work progressed. Just below the workman, who is welding a gas-tight seam, is the electrical apparatus

inches in diameter by about 13 feet in length. It has a capacity of about 423.8 cubic feet, sufficient for accommodating six tons of lignite.

The two conveying screws supplying the pulverized coal to the locomotive nozzles are capable of dealing with a maximum of 4630 pounds per hour at a maximum rate of 140 revolutions per minute, the amount of fuel actually supplied being controlled by the number of revolutions made by these screws.

Primary air is supplied by a blower driven by a simple steam turbine and paddle wheel, its maximum output being seven horsepower. A small steam engine is used to drive the slowly-rotating conveying screws. A small auxiliary burner at the rear wall of the ash pan serves as an igniter while the locomotive is stationary or when coasting, and is intended to make up for the radiation losses of the boiler and for supplying steam for the air pump. The tender loaded with pulverized coal weighs about 3.8 tons more than a standard locomotive tender of the same class.

The air-pulverized coal mixture blown into the firebox comprises only a part of the air required for combustion in the form of primary air, the balance, or secondary air, being drawn in automatically, as in an ordinary steam locomotive, by the stack draught. The mixture is blown into two long nozzles facing one another below the firebox. There it is dissipated into a large number of narrow streams or bands. These are formed at an angle of 90 degrees, so as to strike one another in the center of the firebox, where a violent vortex is produced.

The rising pulverized-fuel flames strike the strongly preheated secondary air below the brick arch. The heated gases are deflected upwards at the end of the long arch at a very high speed, thus causing the slag particles to be granulated on the upper surface of the firebox, so that no slag clings to the tube orifices.

After a few trials running idle, the two pulverized-fuel locomotives so far constructed were put to work hauling freight trains on the usual schedules on one of the sections of the main lines. During the trial runs it sometimes happened that pulverized lignite and ordinary pit coal were stored above one another in the tender. This never gave rise to any inconvenience, although a change over from one fuel to the other was effected during a journey.

The main advantages of the new system are that the fuel cost is reduced by the possibility of using lower grade fuel, particularly peat or lignite, and by the ease with which a change-over may be made from one kind of fuel to the other. The time required for cleaning the firebox is reduced to a minimum, and there are no fuel losses in discharging the slag. Thus the duration of a continuous run is limited only by the capacity of the coal bunker.

Courtesy *Railway Age*

The successful pulverized coal locomotive recently built in Germany

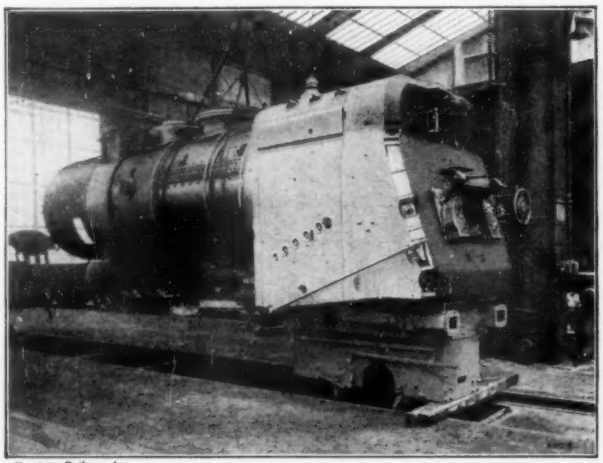
Smoke emission is reduced to a minimum, and spark throwing is practically, if not entirely eliminated. Greater cleanliness is secured for the driver and fireman, and the call upon the fireman's physical exertions is lowered considerably.—*Written especially for* SCIENTIFIC AMERICAN *by Dr. Alfred Gradenwitz.*

Out-of-Door Television—The Latest Advance

BRINGING television out of doors is the feat most recently performed by the scientist-inventors, Dr. Herbert E. Ives and Dr. Frank Gray of the Bell Telephone Laboratories in New York. Their apparatus will now enable one to follow the motions of a prize fighter, the activity of an athletic contest, or the gestures of a presidential candidate at the same time that his voice is heard over the radio. Heretofore the view has been limited to that of a face or moving hand held close to the transmitting apparatus and "scanned" by means of a rapidly moving pencil of light.

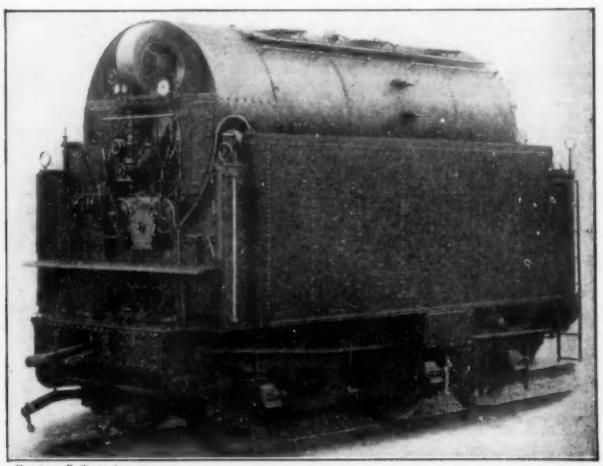
The new modification of the Ives television system was recently seen by a representative of the SCIENTIFIC AMERICAN, who sat in a darkened room on the seventh floor of the Bell Telephone Laboratories in New York and through the medium of a telephone commanded the activities of two men who stood before the transmitting apparatus several stories above on the roof, and whose images were clearly visible on the screen before him. The demonstration left the impression that the long-sought transmission of public events into the home was measurably nearer.

The reader is doubtless familiar with the Ives system of television, as it has been widely described before. It will be recalled that the object to be transmitted was placed immediately in front of a revolving disk of metal having a single spiral of small holes drilled around its outer edge. Through these holes shone a powerful beam from an arc light. The method of scanning the object was most clearly demonstrable by first stopping the motor which caused the disk to revolve. When this was done a single spot of light, and *only* one, was seen to be reaching the object. By slowly turning the disk over by hand this spot was made to traverse the object from side to side, but just as it passed off from the object at the left a new spot was seen to follow it on at the right. This new spot of light, however, was slightly lower, for the pencil of light passed through a hole slightly nearer the center of the disk. The third spot, in turn, traversed another parallel path across the object; and so on for the fourth and all the remaining paths, the whole process being repeated with each revolution of the disk. By starting the motor this process could be followed by the eye until, as the motor speeded up, it became too rapid for the eye to follow,



Courtesy *Railway Age*

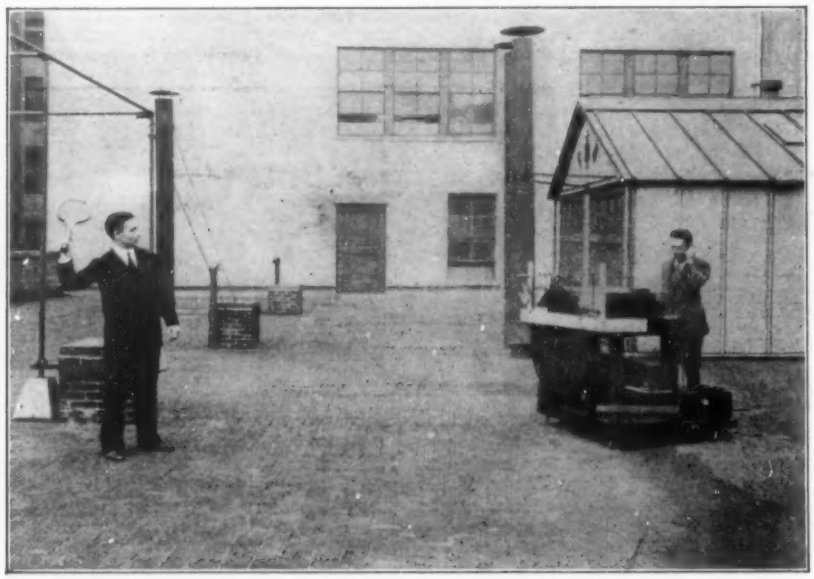
The boiler of the pulverized coal locomotive, under construction, showing nozzle and ash pan structure



Courtesy *Railway Age*

The tender of this locomotive is built in the form of a tank to carry the previously pulverized prepared fuel

or even for the mind to conceive. One knew, however, that the beam of light was scanning every inch of the surface of the object many times a second, and that every variation in light reflected from that object, caused a corresponding variation in the electrical current flowing through the large photoelectric cells in the immediate vincinity.



The transmitting apparatus for the Ives-Gray out-of-door television system installed on the roof of the Bell Telephone Laboratories in New York City

Doctors Ives and Gray have now made certain variations in that simple process which enable outdoor objects to be transmitted. Obviously the object is constantly illuminated all over, and not by a moving beam, as previously, since it is now illuminated by the Sun.

The scene or event to be transmitted is reduced to the form of an image by a large lens, this image being exposed to a single photoelectric cell through a rapidly rotating disk similar to that previously employed but several times as large. The lens serves somewhat the same purpose in the television apparatus as the large lens of an astronomical telescope, and, like the latter, it should be large to gather as much light as possible.

The experiments show that moving persons and objects can be successfully "televised," although at a considerable distance from the lens and therefore in such a position that the focus of the lens does not require changing from moment to moment. An improved photoelectric cell is used, the disk of the new apparatus is larger (38 inches in diameter) and with its 50 holes drilled in a spiral it rotates at the rate of 18 revolutions per second, but there are no essentially new elements in the aparatus except the lens.

Further Light on the Use of Old Tires

THE following excerpt is from a letter recently received by the editor. It interested us very much so we asked and received the writer's permission to publish it.

"Your short item and photograph on page 541 of the June issue regarding the use of old tires for shoes by the peasants of Macedonia, leads me to mention a similar use of them, through virtue of necessity, in an entirely different quarter of the world.

"While on a cruise in April of this year to the Galapagos Islands, we came upon a party of 32 men marooned on James Island. They had been there for several months, had used up all their supplies, and were then living entirely 'on the country,' their principal articles of diet being ducks, turtle's eggs, and flamingoes—a rather unusual combination. They had been left on the island to mine sulphur from some of the volcanic craters there but, some mishap having occurred to the ship that had brought them, prior to its return to Guayaquil, they had been entirely without supplies or visitors until we came along.

"A number of these men were shod with shoes very similar to those in your illustration. These shoes were fastened with thongs of seal skin, since no other material was available. They were extremely useful on the rough lava flows which furnish about the only highways of communication on that desolate island. Probably the prior use of these old tires had been as bumpers on the row-boat with which the men were equipped."—Leslie Watson.

Synthetic Vinegar Lacks Vitamins

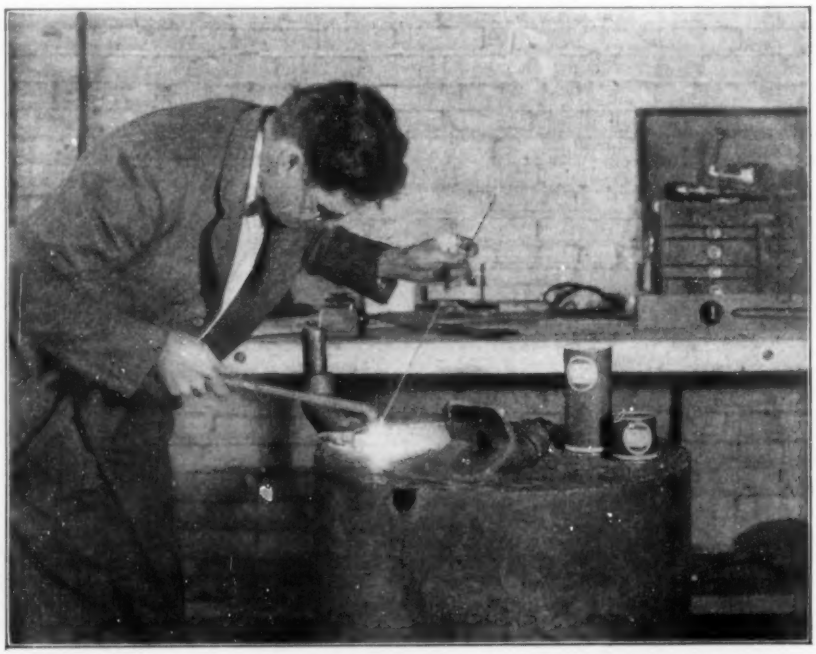
VINEGAR made by the old-fashioned fermentation process is far superior to synthetic acetic acid, German scientists have found. While all vinegars vary greatly in their vitamin content, the synthetic variety is lacking in vitamin D, the important food factor that prevents rickets in children, report Dr. A. Janke and H. Lacroix.—*Science Service.*

Bronze-welding Cast Iron

BRONZE welding, although desirable at times, is often unsatisfactory because the bronze filler can seldom be made to adhere to, and form a strong bond with, the iron. Furthermore, the joint usually has to be made bulky and unsightly in order to give it strength.

The Simplex Flux and Solder Company has developed a method of welding cast iron that, according to reports, makes possible the practical welding of two different metals with a filler foreign to both, yet without destroying the base structure of any of the three. It is called the Lotan combination powder and flux method.

The equipment used in welding by this method is the ordinary oxy-acetylene torch, bronze or brass filler rod, and the Lotan combination which consists of a special powder preparation and a special flux. In operation, the pieces are laid together and the edge or joint is heated just above black heat. The powder is then sprinkled over the joint so that the torch may blow it into the surface of the iron. After heating this properly, the brazing rod, which



This photograph shows the ease of bronze-welding cast-iron fittings to steel, a job hitherto considered by engineers to be impossible of accomplishment

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As resilient as a watch spring. Fine, tapered point, ground fine to shade at any angle. Loved by stenographers.

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An improved stub point. This point makes a broad line. May be held in any position. Liked by rapid writers.

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A different pen point The tip is ball shape Makes a heavy, characteristic line without pressure. Suits left handed writers.

Thousands of fountain pen users are turning to Waterman's Number Seven. They are delighted with the ease with which they can select a pen point that exactly suits their style of writing. You will be, too, if you step into a store and ask the pen clerk to let you try the six Number Seven points and select the one that suits you best.

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Another example of Waterman's supreme craftsmanship Ink will not stain this beautiful Ripple rubber pen. Made with attractive lip-guard and an unequaled patented filling device.

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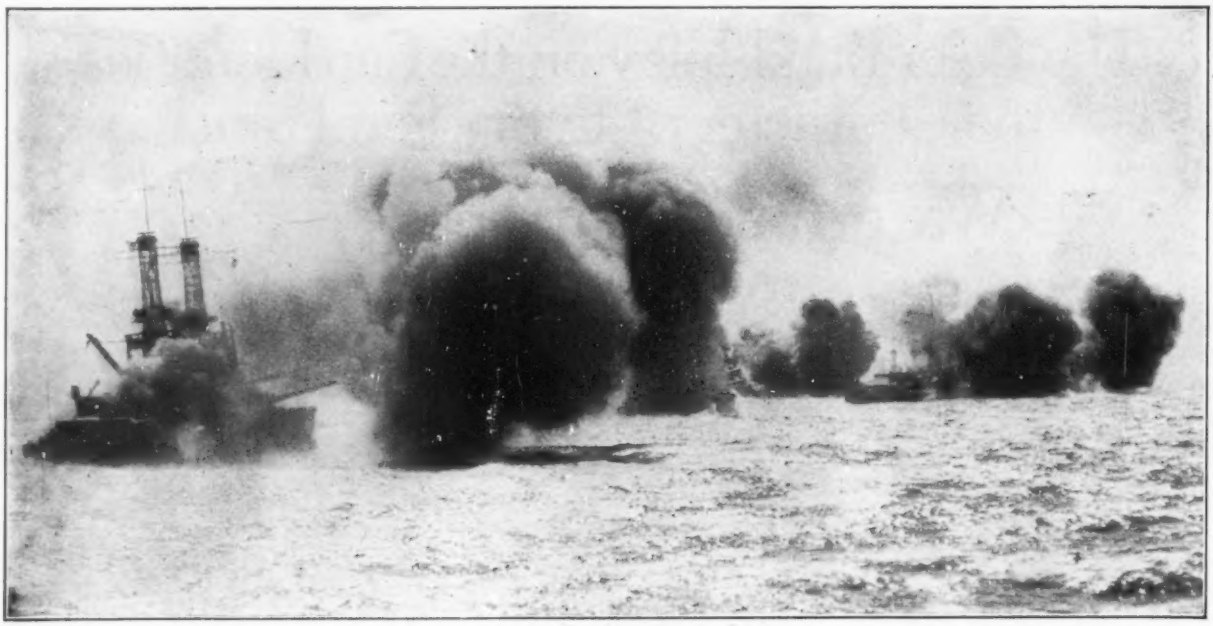

Our Strongest Assurance of Peace

The Washington Disarmament Conference was a magnificent gesture against war. The navies of the world should quit their mad race to excel in armament, so the treaty provided; the heavy burden of cost would be lifted from the shoulders of all peoples and there would be no further incentive to fight.

But, now that we can study the facts calmly,

Did America get a fair break?

Have we the strength the treaty intended we should have?

Are we seduced into building no more ships by the belief that our navy is adequate now?

Can we awaken the public to the true state of affairs before it is too late?

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has been dipped in the special flux, is then applied and melted into the joint by means of the torch. It is said to give an extremely strong joint that may be machined easily, and is not bulky.

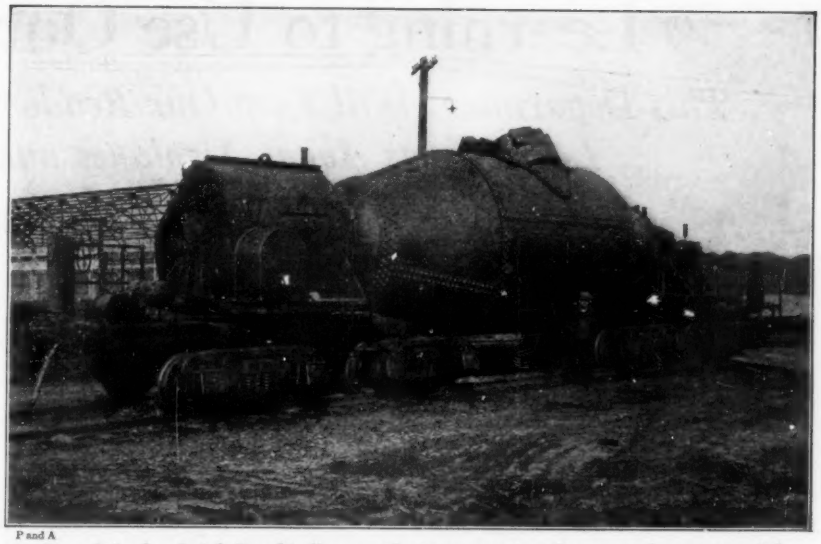
The specific feature of this method is that it offers new economies for designing and production engineers to whom it would never occur otherwise to specify cast iron fittings for a steel unit. Cast iron fittings are, of course, less expensive than steel fittings but a way to weld them had not been thought practical hitherto.

The joint bronze-welded by the new method is said to be neat, strong, and machinable when necessary

Largest Molten Metal Transport Car

UNDER an arrangement between the Hamilton Coke and Iron Company and the American Rolling Mill Company, the former has rebuilt and enlarged its furnaces on the northerly edge of Hamilton, Ohio, and will supply molten iron to the rolling mill at Middletown, Ohio. The Baltimore and Ohio Railroad did its share in making the plan practicable by building a 10-mile special road between the two plants.

The building of the road was a major job inasmuch as it was necessary to build all bridges of much greater strength than any hitherto built in order to take care of the extremely heavy loads. The bridge over the Miami River, for example, was designed for a 50 percent greater capacity than any other ever built. The three ladle cars, to be used on this road, are by far the largest ever constructed for such a purpose.



P and A

One of the fire-brick lined ladle cars that transport molten metal over a special road of the Baltimore and Ohio Railroad between Hamilton and Middletown, Ohio. When loaded with molten metal, each huge ladle car weighs 340 tons

In these cars, molten metal will be carried daily between the two plants, two and one half hours being required for a round trip, and the average being four trips in 24 hours. The length of these cars is about 56 feet. They have four axles at each end or a total of sixteen wheels and, when loaded with molten iron, they weigh 685,000 pounds, or 340 tons. The cars are lined with fire brick and provided with lids something like a giant thermos bottle. The molten metal is poured into them at the furnace and after movement to the rolling mill, they are tilted so that the metal runs out like so much water. This is accomplished by having the ladle which carries the iron, on pivots. The tilting is done electrically and safety is provided by arrangements which permit the electrical attachment to be made only when the car is at a standstill. The molten metal can, when necessary, be held in the ladle 48 hours. The capacity of these ladles is 150 tons each.

Noiseless Street Cars

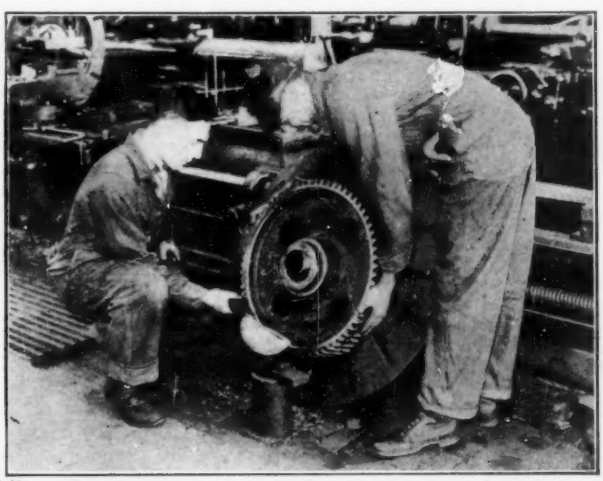
MUCH has been written, especially in letters to the press, regarding the ever increasing noise in our cities, the clang and clatter of machinery and vehicles; and some attempts, more or less productive of results, have been made to muffle or minimize these noises. A noteworthy attempt recently brought to our attention is that of the Market Street Railway Company of San Francisco. This railway had adopted a program for cutting down the clang and clatter of rolling stock and lessening the pounding of cars on the street roadbed.

Already six street cars, 1928 model, which make much less noise than any equally large cars operated in San Francisco at the present, are in operation on the tracks of this company. The clang of these cars is deadened by the use of lead in grooves cut in the inside of the rims of gears; drumming sounds are cut down by

(*Please turn to page* 271)

Wide World

In silencing the street cars in San Francisco, rubber pads were inserted between the trucks and the car body



The clang of gears was cut down by cutting a groove inside the gear rim and pouring melted lead into this

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

A Net of Weather Stations

WHEN the operations of the air mail lines were taken over by private companies, the Airways Division of the Department of Commerce undertook the duty of supplying weather information to pilots. The number of weather reporting stations has been increased rapidly. These stations have been placed as strings roughly paralleling the airways.

Dr. C. G. Rossby, in a paper before the American Society of Mechanical Engineers, suggests that such strings are insufficient

P and A

Of course you all know who these folks are, but their picture belongs with the rest of the aviation news. In the center: Amelia Earhart, first woman transatlantic flyer; left, Louis Gordon, mechanic; and right, Wilmer Stultz, pilot

and that what is needed is a dense network of stations on and surrounding the airway.

Especially in summer time, local disturbances, such as thunderstorms, may drift with the wind across the course and come as a complete surprise to the aviator, even if the "string" of weather stations has done its best to keep him informed. To a certain extent, if a network of weather stations were established, the aviator could, in emergencies, play hide and seek with the weather, and depart from the airway under certain conditions.

The extra cost of such comprehensive meteorological service will be more than compensated for by greater safety and reliability, which in turn will entail greater patronage.

The Daniel Guggenheim Fund for the Promotion of Aeronautics has established such a network on an experimental basis between San Francisco and Los Angeles, where the main obstacles to flying are fog, low clouds and poor visibility.

It is interesting to note how this service works. Three observations are made daily—at 9.30 A.M., 11 A.M. and 12.30 P.M.—covering the part of the day during which most flying is done. The collection and exchange of these weather reports is handled exclusively by telephone. At each terminal, Oakland and Los Angeles, a sequence call, containing the telephone numbers of the various field stations, is filed with the local-long-distance exchanges, and the station is connected with various other stations in succession.

All observers are instructed to wait at their telephones at the report hours and give their reports in standardized terms as soon as the line is clear. While Oakland talks with Modesto, the long distance operator in Oakland is busy hooking up a line to Fresno, thus reducing the time between calls to a minimum. The telephone service has already proved highly efficient, and much progress may be hoped from such weather nets and telephone service.

The Bellanca Sesquiplane

BELLANCA is undoubtedly one of our most original designers, and his latest plane presents many novel and original features.

It has been built for Cesare Sabelli, for a proposed flight from New York to Rome, and will have the great range of approximately 5500 miles—perhaps the greatest airplane range on record. The main characteristics are as follows: length over all, 39 feet one inch; height, 11 feet six inches; span of upper wing, 64 feet six inches; span of lower wing, 36 feet eight inches; wing area, 606 square feet; power plant, Pratt and Whitney Hornet of 500 horsepower; weight empty with normal equipment, 4000 pounds; useful load, 6000 to 8000 pounds; gasoline capacity, 1000 gallons; high speed, 140 miles per hour; range, 5500 miles.

There is little doubt that these estimates of performance will be realized because of two important factors. The first of these is the skill with which the structural weight has been kept down. It is remarkable that the weight empty should be only one third of the gross weight. The second is the extreme aerodynamic refinement of the design.

The Bellanca model K, as it is termed, is a sesquiplane. We are not quite sure that this designation is linguistically correct, but sesquiplane has come to mean a plane and a half, a cross between a monoplane and a biplane, with the larger wing generally the upper one.

Since a monoplane is always more efficient aerodynamically than a biplane, it may be asked why Bellanca has departed from his usual monoplane practice. The answer is that this sesquiplane design lends itself particularly well to the incorporation of a retractible chassis. The lower, thick wing is brought downwards from the body at a negative dihedral, to put it technically, so that its tip is comparatively near the ground. The supporting struts of the landing gear, placed at the tip of the lower wing, are therefore very short.

The thick, stub-like wing also serves to house the wheels in their retracted position. The landing gear of an airplane may have half the air resistance of the entire fuselage. The greater part of this resistance lies in the large wheels. Therefore, from a performance point of view, it is well worth while to withdraw the chassis while in flight. It is quite certain that many commercial designs will follow with retractible chassis.

The only drawbacks to retractible chassis are: the possibility that an absent-minded aviator may forget to extend the chassis when alighting, and the mechanical complication involved. There are several

P and A

Bellanca sesquiplane *Roma*, in flight with wheels retracted

instances on record of aviators who have landed amphibians on dry land with chassis withdrawn, but the procedure is not necessarily fatal, and the mechanical complications are not so very great.

The landing gear wheels are each supported by two steel members, both on the inner side of the wheel. The forward member is almost vertical, being slightly bent to bring the wheel farther forward. The front strut is mounted through a shock-absorber mechanism to the forward spar of the lower wing. The rear member is mounted on a ball and socket joint at the rear spar. The two vertical struts are prevented from side motion by two heavy tubes, one on each side. To retract the landing gear, the bracing tubes on each side are drawn back towards the trailing edge, and steel cables simultaneously draw the wheels into the wing as they swing about the rear ball and socket joint.

Another aerodynamic refinement, which Bellanca has already used in the past, is in the outer struts which go from the tip of the lower wing to a point in the upper wing. These are of airfoil section, and have about two thirds the lift of an ordinary wing, in proportion to their area. Since there must be struts for bracing, why not make them do some work in lifting, instead of acting as purely resistance producing elements?

The sesquiplane carries 1000 gallons of fuel, of which 600 gallons are carried in the fuselage behind the pilot. Behind this fuel compartment are housed the navigator and the radio man, with all the instruments that the hearts of long-distance flyers can desire.

The remaining 400 gallons of gas is housed by Bellanca in the upper wing. He has answered, in these tanks, another very logical question. Why not make the wing structure itself be the gas tank? The entire inner bay of the upper wing is indeed a gas tank. Upper and lower wing coverings are made with liquid tight seams. The spars are of dural, perforated with holes to permit the gasoline to flow freely from front to rear of the tanks. The ribs, with holes top and bottom, act as anti-swash plates. The combination of tank and wing weighs far less than would a wing with separate tank.

Wide World

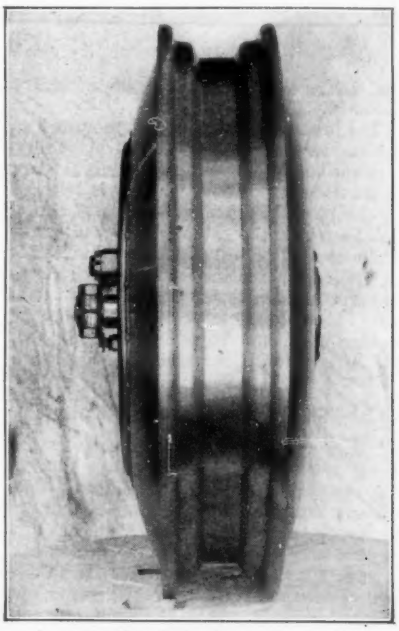
The *Roma*, with tail up, taking off from Roosevelt Field, New York

Wheels and Brakes

THE airplane is by far the most refined vehicle of transportation. Even in such items as wheels, it leads in lightness and strength of construction. Brakes, which were at first opposed even by the experienced operators of the air mail service, are now almost universally employed.

The Bendix-Laddon wheel, shown in one of our photographs, is built entirely of duralumin. It has as perfect a streamline as it is possible to give a wheel. It is entirely watertight. A 32-inch by six-inch wheel, complete with brake weighs only 28 pounds, yet it has a radial strength of 10 tons!

Another photograph shows the brake mechanism and its housing, just as it is to be put into the wheel. The brake is of the well known two-shoe Servo type, which has proved so useful in the automobile. The cam to apply the first shoe is turned in the same direction as the rotation of the wheel when the plane is traveling in a forward direction. The friction between the wheel and the brake band then serves to bring the second brake into action by a system of linkages. Thus the brake is self-energising and requires a minimum of effort for its operation.



A streamlined airplane wheel, with brake, built of duralumin

The mounting of the brake control system is quite an engineering problem. Our diagram shows a typical installation, with

Wide World

Front end of the *Roma*, showing pilots' cockpit enclosed, and the powerful radial engine in the nose. Cesare Sabelli, pilot, is shown at the controls

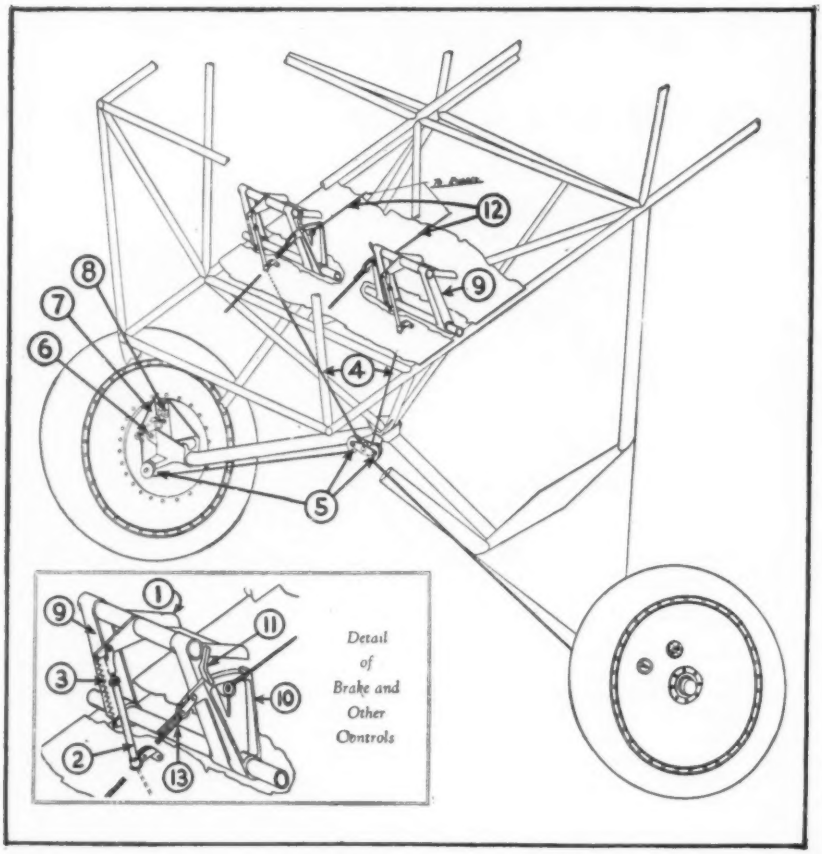


Diagram of airplane wheel-brake installation

the numbers showing the most important parts.

The brake control pad, 1, is mounted on the rudder pedal 9. The control pad return spring, 3, always returns the brake pad to its normal position, when it is released by the pilot. Part 2 is the parallel action link to which the cable is attached. The brake control cables, 4, pass over pulleys 5, to the brake actuating lever 6, which serves to turn the cam that actuates the internal mechanism shown in our photograph. The rudder pedal can be adjusted by a pawl, 11. An elastic, 13, serves as a pedal return.

Can There Be a Rocket Airplane?

FOR many years, interstellar navigation by means of rocket-propelled cylinders has been a subject of discussion and some experimentation. The recent German experiments with rocket propelled cars and gliders have attracted much attention, and it is now asked whether rocket-driven airplanes are not possible, navigating at fantastic speeds. It is impossible at this early stage of development to venture a definite opinion. But it may be of interest to our readers to review the various principles involved.

In the *Journal of the American Society of Mechanical Engineers*, we find some useful primary information on the rocket.

The Chinese, who are supposed to have invented gunpowder, have long used it for celebrations. The rocket began in the same way, as a pyrotechnical device. At a later date, its great visibility led to its employment for purposes of signaling as in the Coston ship rocket, the use of which has now developed into an elaborate technique. For a while the rocket was considered as a military weapon, but the rapid-fire three-inch gun and the Stokes mortar put an end to this idea.

As to the actual mechanical principles of the rocket, but little is understood even to this day. The rocket works on the reaction principle, the reaction being between the gases of combustion and the chamber in which they are contained. It does not work by reaction between the gases and the air, as might at first be supposed. In fact Professor Goddard, who has devoted so much time to the problem, has shown that a rocket moves faster in a vacuum than it does in air.

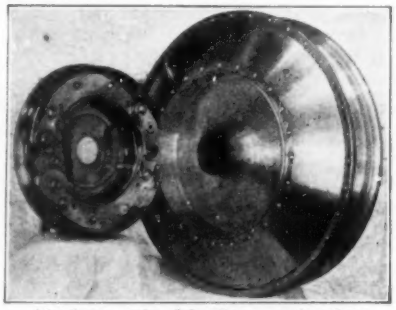
The ordinary pyrotechnical rocket is very inefficient because, since it is made of paper, its chamber cannot work with a high pressure; and it is the pressure in the rocket which determines the velocity of efflux of the gases which, in turn, determines the efficiency of the device. Because of this, the velocity of the flow of gases in an ordinary rocket is only of the order of 1000 feet per second, and the efficiency scarcely more than 2 percent. With steel-chamber rockets, velocities of the order of 7000 feet per second become possible, and much higher efficiencies may be expected.

The shape of the rocket has a great deal to do with its efficiency. The best results seem to be obtained with a chamber which is not cylindrical, but which expands towards the exit somewhat like a De Laval turbine nozzle. The composition of the powder and its rate of explosion also have a good deal to do with efficiency.

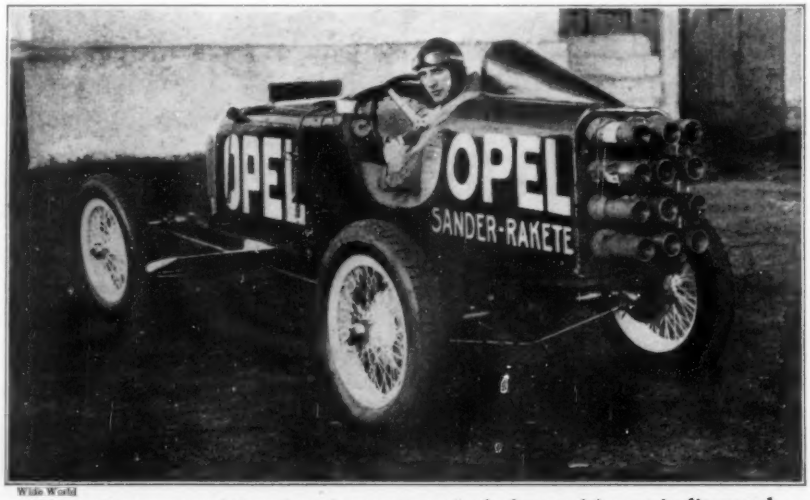
So much for the general principles of the rocket. Now, why should a rocket be applied to locomotion purposes? Certainly not on economic grounds. Gunpowder seems to have enormous energy, and yet a pound of gunpowder gives only one tenth the energy that a pound of gasoline or alcohol will give.

Gunpowder has only one advantage. It contains within itself the oxygen needed for combustion. With gasoline or other fuel, we must have a mechanism in which air is mixed with the fuel, compressed, and

(*Please turn to page* 275)



Airplane wheel-brake mechanism of the self energizing type



Wide World

The rocket automobile using the same method of propulsion as is discussed for airplanes in these columns. The steel tubes protruding from the rear end are part of the rockets, which are to be ignited consecutively by the driver

This *grainless* wood is workable almost beyond belief!

Can be cut out, punched, die cut and milled. Very dense and tough. Highly resistive to moisture. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large free sample.

FOR STORE FIXTURES

American Industry is now pretty well aware of the fact that there is on the market a genuine all-wood board that is *grainless,* that won't crack, split or splinter, and that is highly resistive to moisture.

But there are still many manufacturers and mechanics who do not fully appreciate the truly remarkable workability of Masonite Presdwood.

Containing absolutely no foreign substance of any kind, Presdwood cannot damage tools. It can be used on saw, planer, sander, shaper. It can be cut out, milled, die cut and punched. It also assures economy in cutting panels to size. In fact, it practically eliminates all waste in cutting.

Presdwood has uniform strength, too. It is highly resistive to moisture. It is very dense and tough. It has a smooth attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Wide, wide range of uses

Although it has been on the market only two years, Masonite Presdwood is already in use in scores of industries all over the country.

Presdwood is used extensively in paneling—alike in fine Southern homes, in stores and offices of the East and the Middle West, and in summer cottages of the great North woods.

It is being used in the manufacture of kitchen cabinets, medicine chests, cupboards, tension boards, work-bench tops, tables, desks, book cases, linen chests and china closets.

Toy manufacturers are large users of Presdwood. It is serving in hospitals as bedroom screens and as invalid trays. And it is especially efficient for table tops.

FOR PANELING

Laundries, bakeries and dairies are using Presdwood quite extensively. For example, it goes into the making of clothes hampers. And because of its strength and resistance to moisture, it is being built into bread boxes and patented dairy containers.

A number of Chicago railroads are using Presdwood as dust arresters for journal boxes; various foundries are finding it an ideal material for cooling trays for hot castings; it is also going in to the production of packing cases.

New and unexpected uses

Just recently a manufacturer of portable billiard tables became interested in Presdwood. He is especially impressed by its stout resistance to wear.

A manufacturer of electric light globes is putting Presdwood to a novel use. He bores holes into it to fit his bulbs, and thus they are held tightly while being etched.

Presdwood is also being used to line ventilators and elevator shafts—because of its excellent anti-rattle qualities.

And before this advertisement reaches your eye a number of other Presdwood uses will have been discovered—some of them entirely unexpected uses.

Write today for a large free sample of Presdwood and find out what it will do for you.

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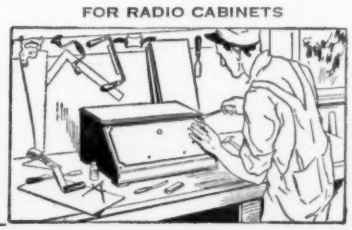

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Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

The Chemistry of Faded Colors

EVERYONE has experienced the shock of finding that the color has faded when a picture is taken from its usual position over the wall paper or when the hem of sister's dress is let down to make it "do" for a while longer. Light has two different effects on dyed fabrics—the color of the material fades or changes hue and the material itself loses strength. Recently, chemists have investigated the causes of these effects with interest stimulated by two new developments, the increasing use of indanthrene dyes and of rayon.

Two theories have been advanced to explain the fading action of light. The "oxidation theory" assumes that the dye stuff is destroyed, directly or indirectly, by the oxygen of the air. The second theory explains the destruction of the dyestuff by the reverse process—that is, the "reduction" of the dyestuff. This "reduction" means the abstraction of oxygen, or the addition ultimately of hydrogen, the dyestuff being in either case converted into colorless or lighter colored substances.

In experiments to isolate and identify the actual products of fading, a pure crystalline substance that proved to be isatin, was obtained. Isatin is an oxidation product of indigo, so that it seems to give proof that the fading of indigo-dyed cotton is a result of oxidation. Other experiments give some evidence that in the case of simple azo dyes, fading is also due to oxidation.

In studying the loss of strength due to the action of light, experiments show that the effect is more marked with some colors, such as orange and yellow, than in the blues and violets.

In the case of the tendering of rayon there seems to be little doubt but that the immediate cause is oxidation of the cellulose as the formation of "oxy-cellulose" can be shown by the usual tests.

Causes of Defects in Canned Foods

PROFESSIONAL humorists assure us that the truly utilitarian gift for the bride today is not a cook book but a can-opener. Such an insinuation, even if true, does not necessarily condemn the modern bride's culinary production, for some mighty tasty food comes in a tinned-iron wrapper nowadays. Yet, in spite of the tireless efforts of the canners to produce perfect foods, certain defects occasionally mar their appearance, some of which are explained as follows by the National Canners Association:

"The coloring matter in the outer coating of some varieties of beans forms a combination with iron which has a dark purple, almost black, color. Special precautions for the canning of such products is necessary. One canner who packs a variety of string beans the seeds of which are slightly colored found that in his canned products the seeds had taken on such a dark color that they showed through the hull, presenting an undesirable appearance. Investigation revealed that he was using a process that was unnecessarily long, and shortening it to the proper length eliminated the dark color.

"Beets are sometimes canned whole and sometimes after slicing. Discoloration has occurred at the center of the sliced beets. This was found to be due to allowing them to stand too long after slicing before they were canned. Under these conditions an enzyme at the center of the beet, which had not been destroyed in blanching, produced a marked darkening. This was eliminated by prompt canning after slicing.

"Ketchup sometimes shows a black band in the neck of the bottle next to the cork. This has been found to be due to a leak in the closure sufficient to admit air but not large enough to admit bacteria and produce spoilage.

"Canned okra sometimes shows a black discoloration on the cut ends of the pieces. This has been found to be due to the use of iron knives for cutting the product.

"Black spots of iron sulfide have occurred in salmon cans, and discolored the salmon and the liquid. These were found to be associated with loose seams and paper gaskets.

"Somewhat similar to these difficulties with regard to discoloration are the complaints that broken glass had been found in salmon, crab and shrimp. Whenever investigated, however, the glass-like particles proved to be crystals of magnesium ammonium phosphate, a harmless substance occurring naturally in these products but only forming visible crystals under certain conditions such as extremely slow cooling."

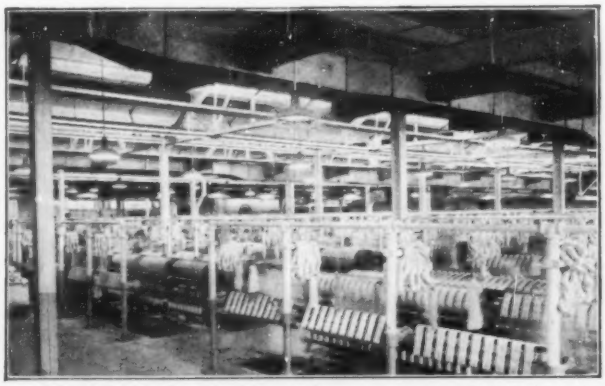
Instrument Analyzes Color

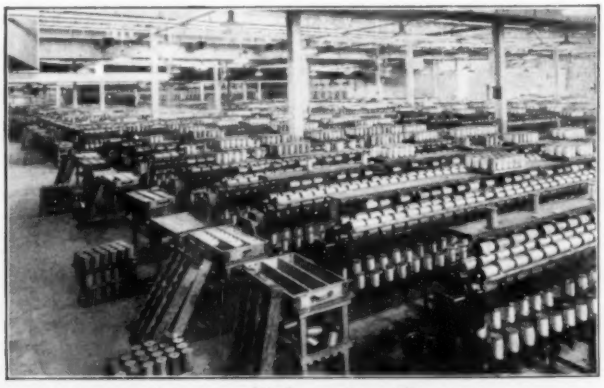
WHEN we are asked to define a color, the answer seems relatively simple if we have a shade in which one of the primary colors such as blue or red strongly predominates, but it becomes more difficult when there is no predominating primary, or when the latter is mixed with a considerable quantity of its complement. Rene Toussaint, writing in *The Paper Industry*, describes the use of a photo-electric cell for analyzing color with scientific precision.

"Color is the resultant of an indefinite number of radiations or shades, each of definite intensity. The intensity or tone of a color indicates the place it occupies on a scale extending from white to black, while its shade or radiation indicates its position on the chromatic scale extending from red to violet.

"A color can therefore be represented in a very simple manner by a curve analogous to a musical staff, in which the abscissas are the shades (expressed in terms of wavelengths) while the ordinates are the luminous intensities. In order to construct such curves, it is sufficient in practice to determine the luminous intensity for the mean wavelength of the six standard zones of the solar spectrum (red, orange, yellow, green, blue, violet). The curve of any color is thus determined by means of six points. The luminous intensity in each case is expressed as the percent of the amount of the same radiation present in a standard white; and the higher the value found the more intense and luminous is that particular shade in the color under consideration.

"In order to be able to analyze and measure colors with accuracy and certainty, it





These two views were taken in the Du Pont plant in Buffalo where rayon is manufactured. The wide-spread use of this comparatively new textile has stimulated research as to the cause of fading colors. Some interesting results of the experiments with dyed goods which have been conducted are outlined in the text above

PUBLIC APPROVAL

. . . is revealed in the most concrete and convincing way by sales . . . .

A BUYER'S name on the dotted line of an order blank is high praise—sincere, conclusive, convincing.

And careful buyers, thousands of them, are purchasing these 6 cylinder Graham Brothers Trucks—enthusiastic over their smooth, obedient power, proud of their fine appearance, surprised at the speed obtainable with perfect safety because of their 4-wheel brakes . . . .

Claims, promises and ballyhoo are crushed under the weight of purchasers' dollars.

See these trucks . . . . Drive the size that fits your business needs—they are built in the sizes that fit 95% of all hauling or delivery requirements.

Ask your local Dodge Brothers Dealer to demonstrate. You will see *why* truck operators everywhere are buying—*why* deliveries are being made at the rate of more than 300 a day.

$665 MERCHANTS EXPRESS 110" wheelbase

$775 COMMERCIAL TRUCK 120" wheelbase

$995 1¼-TON—130" wheelbase

$1065 1¼-TON—140" wheelbase

$1345 1¾-TON—150" wheelbase

$1415 1¾-TON—165" wheelbase

$1595 2½-TON—150" wheelbase

$1665 2½-TON—165" wheelbase

Chassis f. o. b. Detroit

GRAHAM BROTHERS TRUCKS

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is necessary to replace the eye by some reliable device. Such is the photo-electric cell in the form which has been developed by the Société de Recherches et Perfectionnements Industriels, of Paris. It consists of a glass bulb coated inside with metallic potassium, which acts as cathode, and containing a tungsten ring which acts

Kneading rubber in a mixing mill, to incorporate the ingredients

as anode. The cell is inserted in a circuit comprising a 120-volt battery and a galvanometer. When a beam of light falls on the cell, the potassium gives off electrons which vary the conductivity of the cell and consequently the intensity of the current flowing through the circuit. As the current is proportional to the light energy received by the cell, the galvanometer gives an absolute measure of the quantity of light received and acts as a photometer.

"The operation of the instrument is quite simple. Light from a suitable source (preferably a Philipps 'Pintolite' lamp, in which an arc is struck between two two-millimeter tungsten spheres,) is first passed through a condenser to concentrate the rays and is then directed on to the sample, from which it is reflected on to the photo-electric cell, causing an immediate variation in the current flowing through the galvanometer.

"In order to construct the curve of any given color, six color screens (violet, blue, green, yellow, orange, and red), are interposed successively between the condenser and the sample stand, and two readings are taken with each screen, one with the sample and one with the standard.

"We have already seen that the curve of any given color is determined by means of six points giving the value or intensity of the violet, blue, green, yellow, orange, and red entering into its composition. In order to determine these six points, readings are taken on the sample and on the standard with each of the monochromatic filters previously mentioned, and the ratio between the two readings is calculated for each color."

Among the applications of the instrument may be cited matching colors, measuring gloss and transparency, testing and comparing dyes, preparing dyeing formulas, et cetera.

Water Dispersions of Rubber Find Wide Application

A MAGICIAN friend of mine, who is also something of a chemist, is fond of explaining that the way he is able to restore the paper napkin previously torn into fragments is by using a specially made paper in which rubber is added to the fiber during manufacture. This "explanation" from my nimble-fingered friend's "patter" has never seemed quite as satisfactory to me as my own private suspicion that he substitutes a duplicate napkin by some hokus pokus of legerdemain. But recently there have come into prominence such promising developments in the applications of water dispersions of rubber that it begins to look as though rubber technologists may soon accomplish tricks of their own which will find widespread commercial application.

Attempts to use the sap of the rubber tree (known as latex) in its original liquid form date back to the beginning of the rubber industry itself, but its industrial applications have been limited. Recently, however, chemists have devised methods of producing what amounts to a synthetic latex by dispersing crude or re-claimed rubber in water by treating it in a suitable mixer in the presence of a hydrophilic colloid.

Hydrophilic colloids have a peptizing action which reduces the interfacial tension between the rubber particles so that they no longer adhere to each other but become dispersed. Some of the available dispersing agents are fatty acids and their salts, resin acids, glues, saponins, albumins, caseins, and colloidal clays.

Among the commercial applications of dispersed rubber may be mentioned its use in the manufacture of automobile top material instead of the usual rubber cement; in the backing of rugs, carpets, mats, et cetera; and in the manufacture of raincoats, cloth bags and sacks for shipments which must be kept dry. Paper impregnated with aqueous dispersions shows increased tensile strength, resistance to tear, flexibility, and water-resisting properties. Dispersed rubber is being used in the canning industry for sealing the seams of tin containers.

H. A. Winkelmann, writing in *India Rubber World*, predicts that the development of aqueous dispersions will rank in importance with such contributions to rubber technology as accelerators, anti-oxidants, anode rubber, et cetera, and that rubber in this new form will find useful applications in many other fields.

New Tires for Old

WHEN the garage man shakes his head mournfully over a thoroughly deflated "flat" and remarks, "I might be able to fix it, but it won't last," the average motorist loses all interest in the career of that particular piece of rubber. Not so, however, the rubber reclaim man, who sees in the unprepossessing erstwhile "shoe," raw material for his industry, which supplies millions of pounds of reclaimed rubber to the rubber industry. Formerly designated by the derogatory name "shoddy," reclaimed rubber has come to be a vital factor in the industry, and a thoroughly reputable ingredient of the best tires.

The old tires are sorted and suitably blended, ground to size, and digested at high pressures with caustic solution to destroy the cotton fabric. Next the digested stock is washed and dewatered, then dried, milled, and refined. The reclaiming process is a refined chemical industry in itself, and one which has been greatly improved and developed in recent years. Most of this improvement has been confined, however, to the development of more efficient manufacturing apparatus, rather than to any fundamental changes in the method of recovering the rubber.

Paul S. Shoaff, of the Goodyear Tire and Rubber Company, one of the leading

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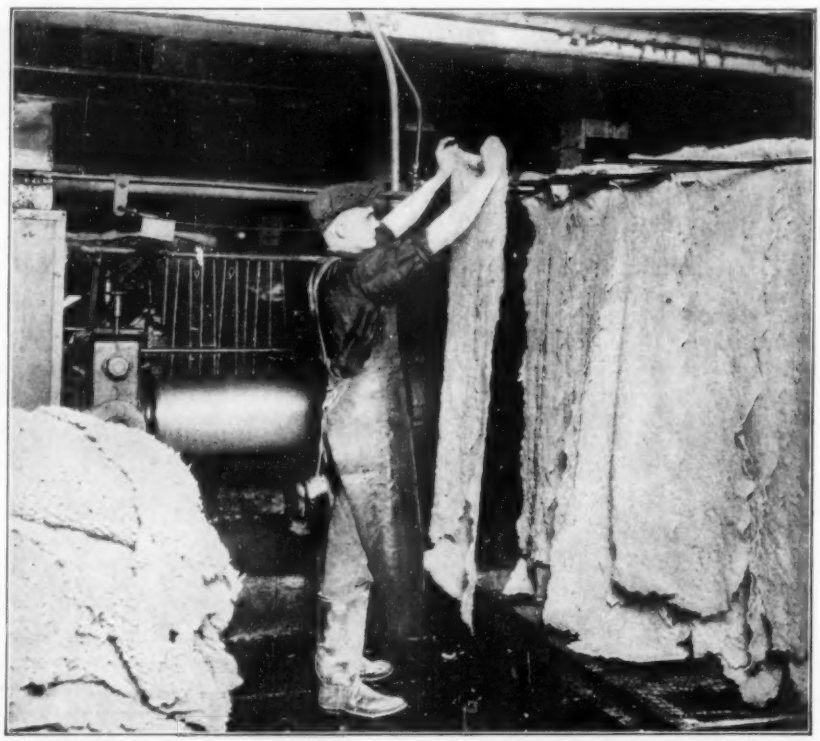


The final step in the milling process in rubber manufacture. The sheets of crude rubber that are being hung up on the rack are known as crepe rubber

Boston Massacre

. . . "Fire if you dare, fire and be damned!" An icy snowball thudded against Captain Preston's well-tailored ribs. Trembling with rage, he cautioned his men: "Hold your peace!" A group of shivering idlers on the Boston street rapidly became a mob.

The mob pressed closer. "Lobster-backs!" jeered one Crispus Attucks, coffee-hued blackamoor. Then cat-calls, vile and insulting epithets, followed by a volley of hard-packed snowballs, some rock-pitted.

The Redcoats made little noises with their guns. "Hold your peace!" cried Captain Preston. They did; but the mob, now one great stupid animal, got louder, and the big-lipped Negro bolder. Soon he found a smooth pine board, raised it, thwacked a soldier's rump. The Redcoat turned, point-blanked his musket in Attucks' face. Spit! Flash! Crack! Negro Attucks screeched, fell dead. Other muskets spat and flashed. The mob recoiled in panic, leaving a sprawl of bodies (five starkly stiff) in the street. Blood oozed on the dirty snow. The soldiers, now ashamed, stood quiet. Captain Preston walked down the line, struck up their guns.

But it was too late to pretend that Massachusetts had not defied its King. Drums beat, bells tolled, more Redcoats issued from the barracks.

"The Governor! The Governor!" . . . Acting-Governor Hutchison, white face set in hard lines, shouldered through the mob. "Captain Preston, what means this?" he thundered. "Consider yourself and your men under arrest, sir." To the mob: "Disperse at once, to your homes." . . .

So, in part, TIME would have reported the Boston Massacre of March 5, 1770, under the reign of King George III. Nor would TIME have omitted the events aggravating the affray—the townsmen's just resentment at the presence of two British regiments in the free capital of a loyal province, their just rage at having to pay for Redcoat board and keep.

So, too, would TIME have reported the turbulent mass-meeting of the day after: how Samuel Adams, popular emissary, forced Acting-Governor Hutchison to withdraw the troops to Castle William in the harbor. TIME would have stressed the subsequent trial of Captain Preston and his men; how Josiah Quincy and John Adams, patriots both, astute lawyers, defended the soldiers, that even-handed justice might be done.

Cultivated Americans, impatient with cheap sensationalism and windy bias, turn increasingly to publications edited in the historical spirit. These publications, fair-dealing, vigorously impartial, devote themselves to the public weal in the sense that they report what they see, serve no masters, fear no groups.

TIME

The Weekly Newsmagazine

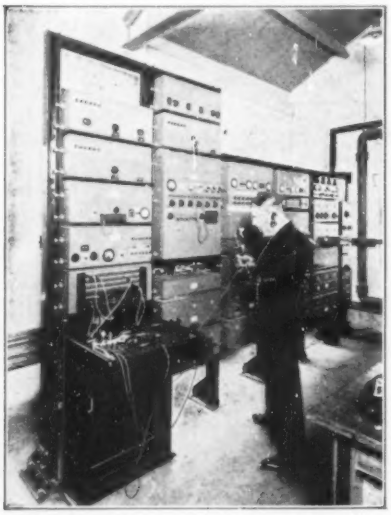
NEW YORK CHICAGO

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Instrument Tests Radio Reproducers

STUDY of such devices as radio loudspeakers on the basis of the sound waves that come to the listener's ear is now possible with an instrument invented by Dr. Dayton C. Miller, of Case School of Applied Science, Cleveland. At a meeting of the American Physical Society held recently, Dr. Miller described this new use of his apparatus, which he calls the "phonodeik." He made the experiments in conjunction with John R. Martin.



Experiments are being conducted at English and Canadian beam radio stations with a system by which one telephone and two telegraph communications can be carried on over the same wavelength. Part of the equipment used is shown here

The phonodeik makes a photographic record of the sound wave as it is received by the ear. Dr. Miller's method is to connect the loudspeaker undergoing test to a microphone, then to record the output on the phonodeik. A similar record can be made of the original sound, and by comparing the two, the characteristics of the speaker determined. When a vacuum-tube voltmeter is substituted for the speaker, the experimenter can determine how much distortion is introduced by the electrical system, and can make allowances for it.—*Science Service.*

Grid-Suppressor Value

MANY radio enthusiasts considering the grid-suppressor method of stabilizing tuned radio-frequency circuits, are apt to hesitate because they are uncertain of the resistance value to employ. Resistance values anywhere from 200 to 3600 ohms are now being used with standard -01-A type tubes in typical tuned radio-frequency circuits. Yet tests show that the resistance value is not critical. From 600 to 800 ohms will usually be found about right when using the -01-A type tube and in the conventional tuned radio-frequency circuit with a plate voltage not exceeding 90. For precise results, of course, it is worth experimenting with higher and lower values of resistance.

The main factor, however, is to avoid inductive resistance. Many types of resistances which will perform well in plate-voltage regulation and other applications, will be found unsatisfactory as grid suppressors. It is also important to guard against capacity effects within the grid suppressor. The latest types of metallized grid suppressor, available in resistance values from 100 to 800 ohms, fulfills the non-inductive and non-capacitative requirements, along with that for silent operation.

Resistance Coupling Essential in Television

WHILE the usual amplifier as now employed for broadcast reception may be utilized in experimental television, the pronounced peaks, together with the limited frequency response of most transformer-coupled amplifiers, will produce distorted television images.

"We all recall the early amplifiers which operated our first loudspeakers," states Mr. Ehle, president of the International Resistance Company. "Because of the novelty of radio in those days, more or less distortion made little difference. It must be much the same with television. In the first thrilling days of experimental television, even the mere outline of a man or hand or other object will suffice, despite splotches and breaks and disfiguration of all kinds, due to faulty amplification at the receiving end.

"However, while the ear may pardon much in the way of distorted music, and even get to like it for that matter, the eye is far more critical. With the eye, a thing must be *right*. Therefore, better amplifiers will be required, and resistance coupling is certain to find extensive use for a nearer approach to uniform amplification over a wider range of frequencies than is necessary in sound reproduction. I understand that even the present admittedly crude television experiments call for frequencies varying from 18 to 25,000! This is far in excess of the 200 to 5000 cycle range which is average for radio rendition."

Good Soldering Prevents Corrosion

THE average experimenter's mistaken idea that solder is used to make both a mechanical and electrical joint is responsible for most of the troubles due to loose and faulty soldered connections, according to P. C. Ripley, of the Chicago Solder Company.

Mr. Ripley, a recognized authority on soldering, goes on to say that solder should be used primarily to protect a joint from corrosion. Its use in making a joint mechanically tight is a secondary function.

The practice of making "butt joints"—that is, of crossing one wire over another or butting the end of one wire up to

Herbert

Wallace Battison, radio NU1-HE, who designed the transmitting and receiving equipment used on the Fokker airplane *Friendship*, on its successful transatlantic flight, at the controls of one of the receivers in his laboratory

another and soldering the intersection—is not conducive to permanency, because soldered joints of that type are mechanically weak and can be loosened by jarring or by the tension which often exists in making them, especially when solid bus bar wire is used.

Conductor connections should always be made mechanically secure and electrically conductive without solder, by twisting or wrapping one conductor around the other. Then solder should be applied as a protection against corrosion, as a means of bringing the greatest surface of one conductor in contact with the other to reduce resistance and as an additional mechanical re-enforcement.

F and A

Radio is now used on board the fire-boats of New York City, and by means of it, alarms may be sent with greater rapidity. Above is one of the boxes from which the alarms are sent, and below is the equipment installed on one of the boats

Herbert

Transformer Inductance Determines Tone

THE ability of an audio transformer to pass the lower musical frequencies—the frequencies which give mellowness and timber to audio reproduction—depends entirely upon its inductance. It has become essential, therefore, according to Ray H. Manson,

The mark of
Hyatt Protection

Serving industry so well for 37 years has privileged Hyatt to symbolize the protection Hyatt Roller Bearings afford to the products which employ them.

Wherever they are applied the presence of Hyatts oftentimes is known only through the economies they effect. So this symbol was designed to visibly identify the inbuilt quality of Hyattized construction.

The *Mark of Hyatt Protection* now appears on many different types and makes of equipment. Seeing this mark, the buyer is reassured.

Perhaps *your* product needs Hyatt protection. Perhaps it would experience a more ready acceptance if equipped with these better bearings.

Without obligation to you, Hyatt engineers are available for conference—any time, anywhere.

HYATT ROLLER BEARING COMPANY

Newark Detroit Pittsburgh Chicago Oakland

HYATT
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

Herbert

The Dornier-Napier seaplane of Captain Courtney, British pilot, on which is installed a short-wave radio transmitter employing the call letters G-CAJI

Chief Engineer of the Stromberg-Carlson Telephone Manufacturing Company, that transformers used in a receiver from which highest naturalness of reproduction is to be expected, must have very high inductance.

"In the manufacture of audio transformers," says Mr. Manson, "there has been a steady increase in the size of iron core used. The purpose of this increased size is to give greater inductance to the transformer.

"In the primary of an audio transformer there are both direct and alternating currents flowing—the direct current going from the 'B' supply to the plate, and the alternating audio current flowing from the plate and filament circuits through the primary to the secondary.

"The presence of high direct current tends to electrically saturate the core of the transformer and pull down its magnetic flux. Alternating current inductance, however, depends to a large degree upon the intensity of this magnetic flux. Thus it is seen that the high direct current, by electrically saturating the iron core, cuts down the alternating current inductance of the transformer.

"It is for these reasons that exceptionally large amounts of iron are now used, in order that the value of the core be so large that even with the high plate voltages used in modern radio receivers, the direct current saturation point of the core cannot be reached."

"B"-Eliminator Hints

THERE is nothing complicated about building a "B"-power unit. Given good components and a reliable rectifier, it is simply a question of proper mounting and wiring, together with these few hints,

Remember that you have a transformer at one end and choke coils at the other. Both have alternating-current flux. Therefore, guard against interacting fields which may cause excessive hum. Provide sufficient separation of units.

Use rubber-covered wire rather than bus bar. There is high voltage in the "B"-power unit. It is well to insulate against it.

Ground all metal cases of transformers, chokes, and condensers. It is well to place an electromagnetic shield, such as sheet iron or roofing tin, over the entire "B"-power assembly to prevent stray energy.

When motor-boating is encountered, try a larger condenser for the "tank" or last filter condenser. Values as high as 12 microfarads will be found to stop many cases of motor-boating, as well as improve tone quality, particularly for the sustained bass notes. Also try an audio choke in each plus "B" lead from the power unit to the audio amplifier, together with two-microfarad condenser between each, a plus "B" lead and minus "B." In the radio-frequency end, try radio-frequency chokes in the plus "B" lead, with a .1 microfarad condenser shunted across the plus radio-frequency plate lead and the minus "B."

Avoid overloading the gaseous rectifier, either through excessive transformer voltage or excessive drain. Overload can be handled by the present-day Raytheon tubes for a short period, but it does no good. Tube life is materially shortened through overload.

New Aircraft Receiver

A NEW radio receiving set for use in aircraft has been designed by Dr. A. Hoyt Taylor and Edwin L. White at the naval research laboratories. Claims that are made for this set are ruggedness, selectivity and elimination of microphonic effects due to vibration.

According to the reports so far received, this set employs a quartz crystal for controlling the received frequency. Also, the variable condensers of the standard well-known type have been eliminated and tuning is accomplished by means of a metallic plate called a tuning disk. The explanation of this last part as given by Dr. Taylor is as follows:

"The metallic disk has such a thickness that the natural period of the metal is outside the range of audibility; that is, its natural period may be above or below the range of audibility but mechanical vibration of the disk is such that no mechanical noises are introduced in the receiving circuit under conditions of vibration."

The set is designed for use for radio telephony and continuous or interrupted continuous telegraphy reception.

Radio in 35 Percent of U. S. Homes

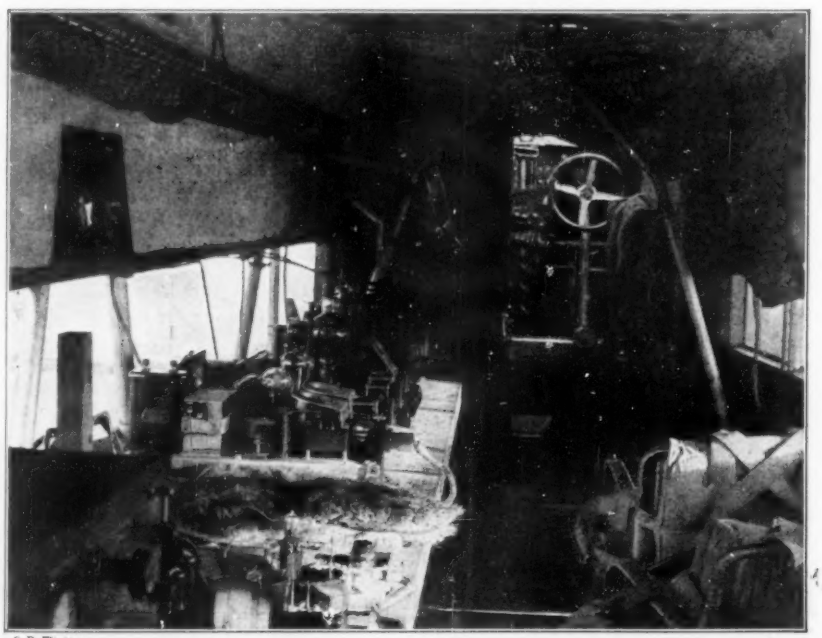
ACCORDING to figures given by Thomas F. Logan when addressing the International Advertising Association in Detroit, Michigan, radio receiving sets are now to be found in 35 percent of the homes in the United States. These sets serve a total audience of 40,000,000.

In discussing the advertising phase of radio, Mr. Logan asserted that first-night audiences of popular musical programs by national advertisers run from ten to fifteen million listeners.

Radio Clergy

BECAUSE of the numbers that radio reaches, and their diversified faiths and beliefs, there is little doubt but that the very near future will find a special "clergy of the air" broadcasting by radio.

This is the belief of Merlin H. Aylesworth, President of the National Broadcasting Company. Some idea of what this clergy of the air will be like will be gleaned from a series of national programs entitled "Great Messages of Religion." In the transmitting of these series, clergymen of the Protestant, Jewish and Roman Catholic faiths will be invited to participate.



S. R. Winters

The Air Corps of the United States War Department has equipped a complete flying radio laboratory with two transmitters, five receivers, and a quantity of testing apparatus. Above is a view of the laboratory in the Fokker plane

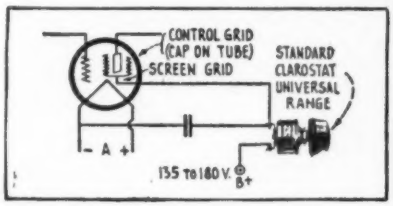
In speaking upon the subject of the "clergy of the air," Mr. Aylesworth said in part: "His creed is of no import: but his views shall be of the broad views of tolerance, and he shall represent the best of religious thought which the experience of 20 centuries has to offer."

Fifteen-Meter Waves

A WAVE of about 15 meters can be received with greater strength and regularity during day-time at distances about or over 5000 miles than at distances of the order of a few hundred miles.

Controlling the Screen Grid Tube

MANY sets and circuits utilizing the new screen-grid tube have been described in various publications. Nevertheless, little or nothing has been said regarding the need for close control of the operating voltages. The manufacturers of shielded grid tubes state that the screen grid should have a 45-volt positive bias, yet in actual practice it has been found that this voltage is quite critical and that it varies considerably with changes in other circuit factors. Under certain conditions, about 20 volts is most satisfactory, while with certain other conditions, up to within



Screen grid tube control

10 volts of the plate voltage provides the most sensitive operation.

It therefore becomes apparent that if this super-sensitive radio tube is to be employed at maximum efficiency, which is usually the intention when using it in place of the standard three-element tube, a high-voltage source, together with a micrometric resistance means of control, is required. The arrangement shown in the accompanying diagram is offered as a suggestion. It will be noted that the 135 or 180 volt source is reduced to the proper applied voltage by means of a standard clarostat, or micrometric variable resistance of enormous range, with a by-pass condenser of at least one microfarad connected across the screen-grid terminal and the negative filament terminal of the tube, so as to prevent feed-back and oscillation. The variable resistance is adjusted until the greatest amplification, together with crystal-clear quality, is obtained.

The plate voltage and grid bias for the screen-grid tube are not critical. The recommended values are 135 volts for the plate and one and one half volts for the grid bias.

European Radio Phone to Canada

RADIO telephone service from England to Canada has been extended so that subscribers in Belgium, Germany, Holland, Sweden, and France may also be served.

Ordinary cables connect these countries to the English transmitter at Rugby, and telephone connections are made in the usual manner. From Rugby the voice currents go via radio to Canada.

This unusual arrangement of wire ropes, sheaves and blocks was used in lowering two 55-ton rotors into the power plant of the Exchequer Dam, in California.

Big Dams!

Mammoth masses of concrete are being built throughout this country to impound millions of gallons of water for the development of power. Such "jobs" employ great quantities of highest grade wire rope, both for handling the structural material and the huge hydraulic machines.

Yellow Strand Wire Rope is always in evidence where loads are heavy—where super-strength is imperative and economy is desirable.

Imported steel wire, specially drawn, and the skill that can result only from vast experience, are responsible for the qualities which make Yellow Strand so popular among contractors of all kinds. The "strand of yellow" identifies the brand and protects the purchaser.

Broderick & Bascom, manufacturers of Yellow Strand, as well as all standard grades, have made wire rope exclusively for over fifty years.

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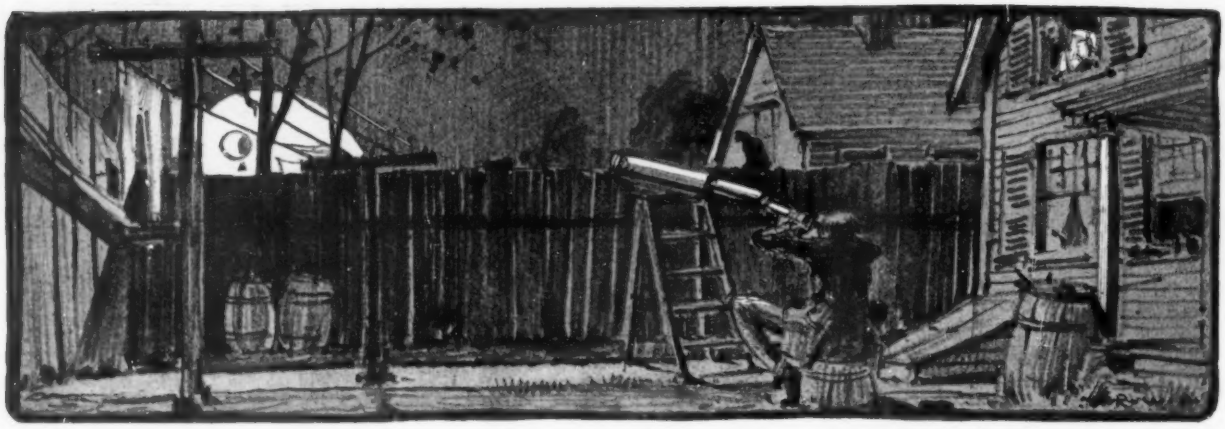
You need a Basline Autowline in your car for emergencies. Made of ¼-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

Yellow Strand WIRE ROPE

MR 463



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

IT is a truly fascinating hobby that will bring together 50 or more of its addicts every year, when these people are forced to traverse several states in order to be present. Every summer the "Amateur Telescope Makers of Springfield," Vermont hold—as most of the habitual readers of this department now know — a sort of informal "get-together" of amateurs, the two-day affair always taking place at "Stellafane," the combined clubhouse-observatory of this interesting group of enthusiasts, situated on top of a fir-clad mountain near that community. The Telescope Editor has just returned from the third of these gatherings and he wishes at this time to urge all amateur telescope makers to lay long-range plans to attend the next meeting, which will be held nearly a year hence.

You go to these "get-togethers" in order to get together. Therefore the time available is not wasted in any foolish formalities but is almost wholly devoted to that which you doubtless wish to do, namely, to meet others who are interested in the hobby in which you are interested, to swop experiences having to do with it, to pick up new ideas and disseminate some of your own if you have any, and in general to keep track of what is going on in the world of telescope making, both amateur and professional.

At this year's meeting, one or two new telescopes were in evidence. These had been brought from afar, the majority of amateurs present having motored to the spot. One amateur, a woman by the way, brought along her mirror and by camping with her family in a tent pitched nearby in a grove, and thus prolonging the stay, she was able to perform the work under the supervision of others of greater experience. Porter, the leader, takes a great deal of interest in the efforts several of the ladies have made, possibly because it has been carelessly said that no woman could hope to make a telescope. None has, thus far, since the present telescope making campaign was begun by the SCIENTIFIC AMERICAN, but we have hopes. However, the conventions will hardly be likely to degenerate into a hen-party, and a man can still attend one of these gatherings in his second or third best suit, if his wife will let him.

There was the usual supper whose "piece of resistance" as someone unfeelingly termed it, was beans baked in the old bean hole. This is simply a hole dug in the earth and heated by means of a prolonged fire, the pot of beans being inserted afterward and cooked all night. One of the "Stellafane" group, Mr. Redfield, happens to be a bang-up good cook and, *mirabile dictu*, he actually likes to cook. He is therefore the hub around which the Springfield amateurs revolve at mealtime.

Russell W. Porter

Fifty-six may not seem to some like a very impressive muster for a convention, yet when you consider that the total number to draw from, that is, the total number who have obtained copies of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," is something like 3000, and that fully half of these live west of the Mississippi or in foreign lands, and further that most of the others had to cover several hundred miles in order to reach the spot in Vermont, the attendance of this number of enthusiasts may be taken to indicate that the hobby is one which takes strong hold of the amateur.

Astronomy is becoming the leading science as far as popular interest is concerned, doubtless because it opens up vistas of grandeur and magnitude which appeal to people of all classes sufficiently intelligent to wonder what (and why) this Universe is. It was recently found by actual analysis that newspaper editors throughout the nation now give more space to astronomy than to any other science; and newspaper editors know what the average person wants.

At the gathering there were no set speeches or formal deliberations, but one could see all day, all night long and during all the next day, the usual knots of enthusiastic amateurs gathered around this or that visitor, soaking up some wrinkle or other; whether an account of the new telescope Professor Ritchey is planning, or a simple demonstration of the use of monochromatic light in figuring a flat, as explained by Porter, or the discussion of the newly available curves of the Schwartzchild telescope as elucidated by Director B. W. St. Clair of the Standardizing Laboratory of the General Electric Company, Lynn Works. There has been a great deal of mystery concerning these curves by means of which, coupled with other refinements of already existing methods, Professor Ritchey expects to obtain much greater results out of telescopes of the sizes at present in use, and even correspondingly more out of the larger instruments which he has planned. We hope to publish the details of these plans in some future issue.

But by all means the most epochal scientific work of the whole convention was the drainage of a small pond in the woods near "Stellafane." It happened this way: One of the less argumentative amateurs

(*Please turn to page* 278)

The Scientific American Digest

(*Continued from page* 257)

heavy rubber pads inserted between the truck and the body; truck noises are broken up by sound deadening material in the car floor; and the air pumps are insulated by the same material.

This company has also developed a new type of rail crossing in which the rails are sealed in a bed of asphalt. Due to the resilience of asphalt, the noise due to the pounding of the wheels across the rail grooves is almost entirely absorbed.

Wide World

Street car noises were further lessened by inserting sound-deadening material beneath the floors. The results have been very satisfactory

The noiseless cars were designed and are being built by the Byllesby Company under whose management the railway is operated.

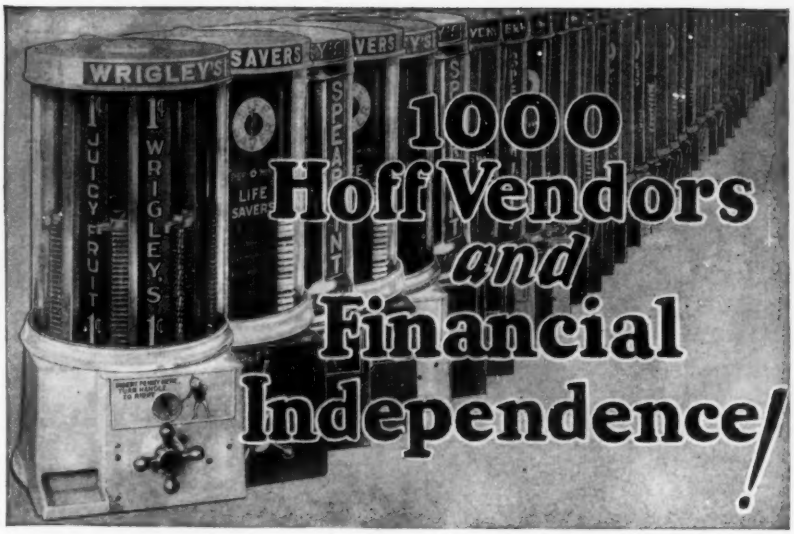
Fishes are Marked by Tattooing

TATTOOING spots under the scales of fish instead of fastening tags on them, is a new method of keeping track of aquarium specimens described by Ancel B. Keys of the Scripps Institution of Oceanography in a recent issue of *Science*. Mr. Keys marks fish too small for the ordinary tagging method by barely puncturing the outer skin with a hypodermic needle loaded with India ink. He reports that his scaly pets suffer no ill effects from the spotting operation, and that the marks last for several weeks.—*Science Service.*

Color Enters the Coal Pile

THE recent outbreak of vivid coloring in pots, pans, refrigerators, gas stoves and other domestic paraphernalia, ushered in by the advertising slogan, "Color Enters the Kitchen," seems to have induced emulation on the part of the cellar. At least, the familiar black diamond of the house-heating furnace is now blossoming forth in bright cerulean hues.

This new departure is due to the enterprise of the Glen Alden Coal Company, which has devised a means for dyeing its high grades of Lackawanna anthracite a bright blue. For some time there has been a movement on foot for the labeling of coal so that the consumer can be sure that he is getting the desired fuel. So far this move-



AN UNUSUAL BUSINESS OPPORTUNITY

FEW of those not in the vending machine business have any conception of the importance that the humble penny assumes when judged by the yearly volume of sales made by penny vending machines. In a single year it amounts to the striking total of over 600 million pennies. Right now there is an opportunity for a limited number of financially responsible individuals to enter the vending machine field, and to make a large profit from the operation of a comparatively small number of vending machines.

THE FAMOUS HOFF VENDING MACHINES

We make the famous Hoff Vending Machine, over 30,000 of which are now in operation, and control the exclusive franchise for distributing in penny vending machines two of the world's largest selling, best advertised, and most popular confections—a famous gum and a famous candy. It is the enormous *demand* for these two products that accounts for the large intake of Hoff Vendors. To further increase this demand, more than $7,500,000 will be spent in 1928 alone to advertise them.

The owner of a chain of Hoff Vendors has a real business. Earnings from month to month vary little. Practical chains consisting of from 250 to 1000 vendors show net earnings of from $2,820.00 to $13,800.00 yearly.

A ONE-MAN BUSINESS

A chain of up to 1000 Hoff Vendors can easily be serviced by one man or woman. The work is easy and pleasant. No previous experience or special training is required. There is no waiting for customers. Earnings start the day a vendor is placed on location. It is a business that can be run right from one's own home.

INTERESTING BOOKLET

We have prepared a book entitled "1000 Hoff Vendors and Financial Independence" which gives the full facts concerning this unusual business opportunity. It tells where vendors can be located, their average earnings, details of the Hoff location franchise, cost of vendors, cost of gum and candy, and cites the experiences of present established Hoff operators, of which there are now more than 70.

Write for this book today. Bear in mind that Hoff Vendors are sold by a division of a five million dollar corporation, and every cooperation is furnished to Hoff operators.

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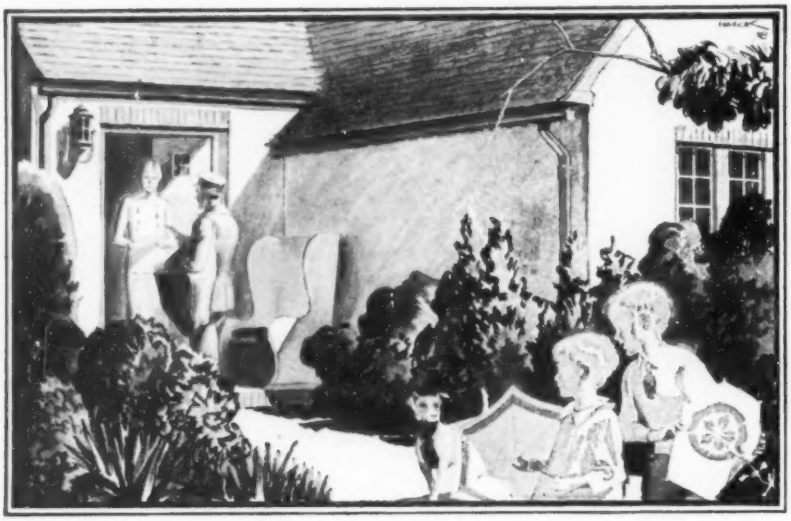

Where the Bell System's profit goes

An Advertisement of the American Telephone and Telegraph Company

THERE is in effect but one profit paid by the Bell Telephone System. This profit is not large, for it is the policy of the Bell System to furnish a constantly improving telephone service at the least cost to the public.

The treasury of the American Telephone and Telegraph Company receives dividends from the stock of the operating companies. It receives a payment from the operating companies for research, engineering and staff work. It receives dividends from the Western Electric Company—makers of supplies for the Bell System—and income from long distance operations.

Only one profit is taken from this money in the American Telephone and Telegraph Company's treasury. That is the regular dividend to its stockholders—now more than 420,000 in number—which it has never missed paying since its incorporation in 1885.

Money beyond regular dividend requirements and a surplus for financial stability is used to give more and better telephone service to the public. This is fundamental in the policy of the company.

The Bell System accepts its responsibility to provide a nation-wide telephone service as a public trust.

Electricity!

Learn in Los Angeles

Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00—unlimited opportunities now.

Practical, intensive training by National's job-experience method in 6 to 9 months. All technical essentials included. School endorsed by leaders in electrical industry. You learn all branches of electricity; radio. Million dollar institution; all modern equipment and training facilities. Life scholarship. No age limit. Free employment service. Over 17,000 successful graduates. 23rd year. Big, illustrated 84-page catalog sent FREE. Write today.

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ment has not progressed to the point where it influences the power plant to any great extent. But it may be that we are entering an era when rainbow-tinted or otherwise trademarked coals will indicate for the purchaser the quality of the fuels he buys.—*Power.*

Three Female Deer With Antlers Found

THREE authentic specimens of female deer, equipped with antlers which are usually the exclusive property of the bucks, are reported to the *Journal of Mammalogy* by Joseph Dixon of the University of California. They were all secured in the same general region, in the neighborhood of Truckee, California. The horns were so developed that all three animals were shot under the impression that they were bucks. The antlers of one of the specimens were imperfectly grown and still "in the velvet" in autumn, but the other two had shed their velvet and were normal buck antlers to all appearance. All three of the animals belonged to the species known as the Rocky Mountain blacktail, or mule deer, and were larger than ordinary does.—*Science Service.*

New Two-Filament Miner's Lamp

A NEW two-filament incandescent lamp for miners, assuring adequate illumination throughout the day, has been developed by engineers of the General Electric Company at the National Lamp Works in Cleveland, Ohio.

The lamp, fitting into a small reflector

The new two-filament miner's lamp described in these columns

fastened to the miner's cap, is operated from a compact two-cell storage battery strapped to a belt about the miner's waist.

The two filaments operate at different intensities. The major filament, giving 14-beam candlepower of light, is used until it fails. Then a simple switch, attached to the side of the lamp, is turned, which throws the current into the low candlepower emergency filament.

This furnishes sufficient illumination for the worker to finish his day's work when a new lamp can be installed at the time the equipment is turned in for recharging the battery. The emergency filament is rated at low candlepower, assuring longer life than if the second filament were of the same candlepower as the first, which dis-

charges the battery in about 12 hours. It is possible to operate the emergency filament for 30 hours or more, should an accident keep the miners underground for an extended period.

"In the past, lamp failures have often occurred when they are being used underground by the miners," C. E. Egeler, engineer of National Lamp Works explained. "It is not a practice at mines to provide a place below the ground for replacing burned-out lamps. Either the miner must be

A miner equipped with the new lamp and accessories. If one filament fails, another is turned on

furnished with another equipment, or he must go to the lamp house on the surface to obtain a new lamp.

"Usually in the past, he stopped work for the day with a loss both to himself and to the mine operator. The introduction in 1919 of a cap lamp equipment having two lamps was a natural development. Only one lamp could be burned at a time, and the other could be turned on should the first fail. Now this condition has been corrected by the two-filament lamps."

Cornell University Gets Wild Life Preserve

CORNELL UNIVERSITY students will be able to carry on field studies in botany and zoology in wild life preserves owned by their alma mater, as the result of gifts of tracts of wild, primeval country presented by the late C. G. Lloyd of Cincinnati. His most recent donation, made just before his death, consists of 110 acres containing three interesting glacial "pot-holes." Two earlier gifts were of 80 and 400 acres, respectively—*Science Service.*

Fish Stories to Aid Science

FISHERMEN who yearn for an audience to listen to the size and weight of their catch are having an ideal time in Wisconsin this summer. A complete survey of game fish in the state is being made by the Wisconsin Geological and Natural History Survey in co-operation with the United States Bureau of Fisheries, and all sportsmen in the region have been called upon to help with the evidence.

For just this once, the fishermen are

The ONE TIRE
that is Engineered for
All Truck and Bus
Service

Firestone
Gum-Dipped Heavy Duty Pneumatics

Never before in history has a tire won ALL records for safety, speed, endurance and mileage in this heavy duty service, because never before has there been a tire so perfectly designed for trucks and buses—with such balanced construction from beads to tread—with every part of the tire engineered to function perfectly under the special conditions that trucks and buses meet.

How have these tires consistently out-performed all others under all conditions—high speed or normal—truck or bus—heavy transport or light delivery?

BETTER ENGINEERING—This is the answer! These tires give record-breaking results because better performance—more miles, greater safety, maximum riding comfort and protection to vehicle—is built into them.

Call the nearest Firestone Service Dealer. He is trained and equipped to save you money and serve you better.

MOST MILES PER DOLLAR

AMERICANS SHOULD PRODUCE THEIR OWN RUBBER Harvey S. Firestone

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METAL CHECKS
STENCILS
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$21.75 Prepaid
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TEN MILE EYES! Think of the things you can see! Ten mile radius—a 20 mile circle—nearly 400 square miles. And you can easily have them. If you can see one mile, these superpower 10 TIMES ENJOY YOURSELF 10 times more! Multiply pleasures of hobby and sport. Use a pair touring, observation, hunting, golfing, nature study, astronomy, etc. Superbly made for a lifetime of service. Case and straps free.

10 Lenses — French 50x20mm stereo-prism binoculars will extend your vision 10 TIMES. ENJOY YOURSELF 10 times more! Multiply pleasures of hobby and sport. Use a pair touring, observation, hunting, golfing, nature study, astronomy, etc. Superbly made for a lifetime of service. Case and straps free.

Did you know many ordinary field glasses have but four lenses and most of the better ones only six? But this binocular has 10 LENSES and 4 PRISMS. No wonder it gives an expansive field, brilliant illumination and fine definition.

4 Prisms — EXTRA POWER WITHOUT EXTRA COST

Send $21.75 today for one on FREE TRIAL. Or $1 for one C. O. D., paying postman balance and few cents postage. Check and compare it in every way for five days with others selling for double or more. If you do not like it for any reason whatever your money will be promptly returned. Every glass tested. The U. S. Gov't and State Forestry Dep'ts buy from us. The same in 8x only $18.50. Surpasses others at $25.50 and more.

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When you're traveling, enjoy the homelike comforts of a Statler. Enjoy—

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All these things — whatever the price of your room — at no extra cost. *The organization of* Statler

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7,700 Rooms with bath and radio reception.
Fixed, unchanging rates posted in all rooms.

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NO DULL SUNDAYS

For Sale by SCIENTIFIC AMERICAN, *Price $5.10 postpaid*

asked positively not to exaggerate the correct weight and length of the fish they capture. But the committee hastens to assure them that the records will not be made public, so no fish stories will be spoiled for social purposes.

The aim of the project is to make each lake produce its maximum amount of game fish best suited to that particular lake. The survey will require a collection of 50,000 samples of fish scales to be used in checking up on the ages of the Wisconsin fish population. The ages of fish can be determined by counting the rings on the scales.—*Science Service.*

Tests Explain Popularity of Pork in United States

INVESTIGATIONS of meat and animal fats by the United States Department of Agriculture continue to explain the popularity of pork in the American diet. Food habits in the United States differ from those in many other countries largely in our very extensive use of pork products. This country, although possessing only about 6 percent of the population of the world, has contained in recent years about 20 percent of the world's swine.

The unusual prominence of pork and its products in the American diet has been the subject of special studies conducted by the Bureau of Animal Industry. In addition to former investigations showing the high nutritive value of pork protein and the ability of pork products to enhance the food value of cereal and vegetable products consumed at the same time, recent studies of sausage are of particular interest. A chemical examination of more than 200 samples showed pure pork sausage to have an exceptionally high fuel value, furnishing more than 2000 calories per pound. This is approximately twice the number of calories ordinarily consumed by the average person at a meal.

A careful selection from the very wide range of pork products makes possible diets containing, on the one hand, an abundant supply of fuel for hard manual labor and, on the other, by a different choice, containing a lesser quantity of energy and more protein, which may be more suitable for persons leading sedentary lives. In general the winter season calls for a greater consumption of foods high in fuel value.

Previous experiments showed pork to be relatively rich in the anti-neuritic vitamin, as determined by feeding experiments with large numbers of pigeons. More recent tests have shown that as small a quantity as 5 percent of dried, lean pork in the diet of the birds protected them against polyneuritis. This disease results from the same vitamin deficiency that causes beriberi in man. Other experiments, conducted to determine the value of pork as a source of the growth-promoting vitamin B, indicate that pork contains a reasonable supply of this valuable nutritive factor. These studies are of special significance since pork amounts to approximately 50 percent of the entire meat dietary in the United States.

The large and efficient production of pork in the country likewise has made it possible for this food to reach the market at comparatively low prices. Its economy, combined with high food value, department officials believe, help to explain the very liberal use of pork products in the American diet.

Learning to Use Our Wings

(*Continued from page* 260)

then ignited, dissipating its energy.

With gunpowder, the process of creating enormous energy can be instantaneous or practically so. Therefore, while a jet-reaction engine, in which gasoline would be burnt in a special chamber, and the exhaust gases pass out through a jet, would be a more efficient reaction mechanism, it would not be one capable of developing enormous energy in a short space of time.

The jet-reaction engine becomes efficient only when the velocity of the outflowing gases is not much greater than the velocity of the air streaming past the moving vehicle which contains the jet-reaction engine.

Therefore when we want to build airplanes flying at 1000 miles an hour or thereabouts, we shall be quite justified in turning to the gas-reaction engine.

The weight of a gas-reaction engine will be appreciable, although not so great as that of an ordinary combustion engine. Its present-day inefficiency may be overcome by special air injectors, or other methods of entraining a large quantity of air with the issuing gases.

But to fly an airplane at 1000 miles an hour will need vast power, much greater than we can get from even a jet-reaction engine of the most developed type.

Suppose we want to anticipate the development of time and attain terrific speeds with an automobile or an airplane today. Is the rocket useful for such a purpose?

It is if we want to get these tremendous speeds for very short periods. We can then disregard economy and by using gunpowder and the rocket, concentrate enormous horsepower capacity in a very small mechanism.

For inter-stellar navigation we need to drive our vehicle for a comparatively short time to get it out of the earth's gravitational influence, and hence again the light, comparatively short-lived rocket is our obvious method of attack.

The Germans first concentrated their efforts on the rocket automobile. The German manufacturer von Opel backed the engineer Max Valier in his device for propelling motor cars by rockets. A translation of the *Hamburger Nachrichten* reads as follows:

"The unusual machine stood on the race track, a low, lightly constructed racing car without a motor. The rear end is a steel box or case, with 12 round openings from which project the blast pipes of Congreve rockets, each having a diameter of nine centimeters. The ignition wires run from the blast pipes to an automatic switch operated by the pilot by means of a foot pedal. Supporting stays are attached invertedly to the car behind the front wheels and have for their purpose the pressing of the car to the track during the run."

The first test made by Volhart, an experienced racing car driver, made an immense impression. The car attained a speed of 60 miles per hour in eight seconds, which is an enormous acceleration, equal to that of the powerful airplane catapult.

From this description it is evident that no wonderful new principles of rocket design have been discovered. Perhaps each rocket was loaded with successive charges or, what is more likely, the rocket was a comparatively slow burning one. In either case nothing wonderful in the purely technical sense is presented.

Now let us turn to the description of the

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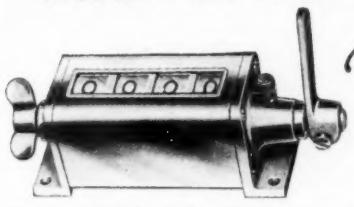

The large Re-Set Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Price, with four figures, as illustrated, $10.00 (subject to discount). Similar model in a Rotary Ratchet Counter, price $11.50.

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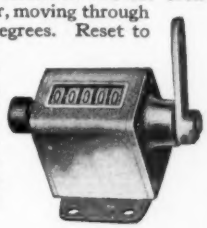

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first airplane flight with rocket, made with the glider *Ente* of the Rhine-Rossiter Experimental Society by Fritz Stamer.

After two failures with smaller rockets, the *Ente* was equipped with two rockets of 20 kilograms (about 44 pounds) thrust. With the aid of the rocket and a rubber catapulting mechanism, Stamer left the ground successfully, flew 230 yards in a straight line, made a turn of about 45 degrees, flew another 300 yards, made another curve of 45 degrees, then lit the second rocket and made another curve and straight flight. Altogether he flew about 1500 yards, in some 80 seconds. The thrust of the burning rocket was apparently quite regular, though weak at the beginning. The burning of the rocket was accompanied by violent sizzling. His experiments ended by the explosion of a rocket, due to preliminary shaking up of the rocket in transit, and the burning of his plane.

As a result of these flights, certain technical lessons emerge, such as measures for fire prevention, placing of rocket in a certain position or balancing it so that the position of the center of gravity does not change when the charge is burned, et cetera.

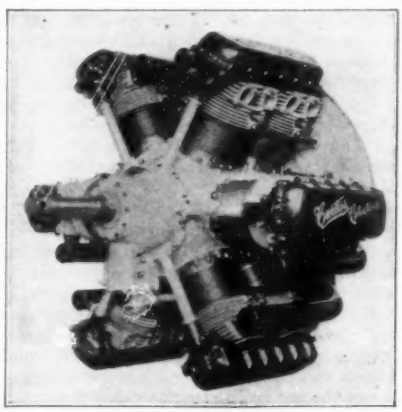
Each rocket burned four kilograms of powder, which is an indication of the enormous expenditure of propulsive material needed for short flights.

On the whole we are inclined to think that the rocket as applied to the airplane might be a means of securing stupendous speeds for a short interval of time, rather than a method of very speedy sustained flight.

The Curtiss Chieftain Engine

ARTHUR NUTT, writing in *Aviation*, gives an illuminating study of the novel and interesting Curtiss Chieftain, a 12-cylinder, hexagon engine, with cylinders arranged in two rows.

The engine develops 600 horsepower, and is the largest air-cooled engine in this country. Installed in a Falcon observation plane it enabled the plane to give a higher performance than any other two-seater plane in the service.



A three-quarter end view of the Chieftain engine, showing how the cylinders are arranged in six sets of two each around the crankcase. Note the large cooling areas

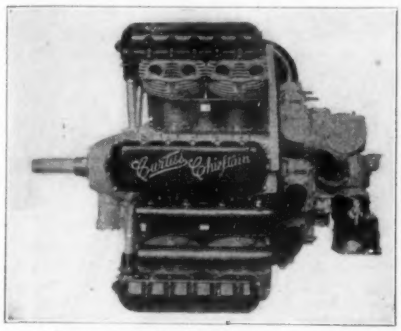
The great problem in the design of the air-cooled engine is to keep down head resistance so as to maintain performance, and to keep the diameter within reason so as not to impede the pilot's vision.

In the Chieftain, these objectives were

attained by having two rows of six cylinders behind one another, instead of having one row of radial cylinders in the same plane.

With the two rows of six, adequate cooling is secured, because the spacing between the engines is comparatively large. When two rows of seven were tried the cooling was found to be insufficient.

Another advantage of the two-row engine



Side view of the Chieftain, showing manifold ports on the upper cylinders, where the manifold has been removed. Head resistance of this engine is low, increasing efficiency

in large powers is that there is far less blanketing of the propeller. The frontal area of the hexagon is approximately one half of a nine-cylinder radial engine of the same power.

The main characteristics of the Chieftain are: 600 horsepower at 2200 revolutions per minute; diameter of engine, 45 inches; bore 5⅝ inches; stroke, 5½ inches; fuel consumption, .53 pounds per horsepower hour; oil consumption, .020 pounds per horsepower hour; total weight 900 pounds or only one and a half pounds per horsepower.

Picking Up Parcels

THE problem of communication between the ground and aircraft is of importance in military maneuvers. Panels, radio, flares, and Very pistols have been used with varying success. Cavalry troops in the Philippine Islands have evolved a "pick up" system which eliminates tedious alphabetical signal transmission, and avoids all errors, since the airplane observer receives the actual map or written message. The apparatus used is very simple and light. A small lead weight is suspened by string, wound on a reel on the side of the observer's cockpit. The line for the message is also a string formed into a large loop. The message is placed in a first-aid pouch, hung to the bottom of the loop, while the upper half of the loop is stretched overhead at arm's length, and held between the fingers of two men, standing about 40 feet apart. The observer unreels 40 or 50 feet of the weighted line, and as the plane flies at right angles across the center of the loop, the weighted line from the plane picks up the loop and its attached message.

A similar "pick up" principle has been successfully employed by Blaine M. Tuxharn, a Kansas City aviator, only he employs a hook attached to the landing gear of the plane. When the hook meets the ground wire, electrical contact is made and a cannon fired. The cannon shoots the parcel forward so that all accelerating jar on the plane is avoided.

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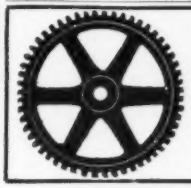

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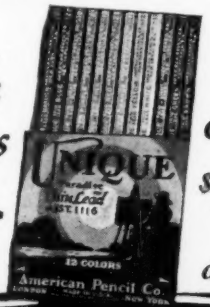

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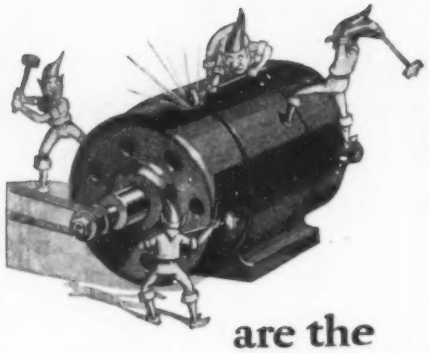

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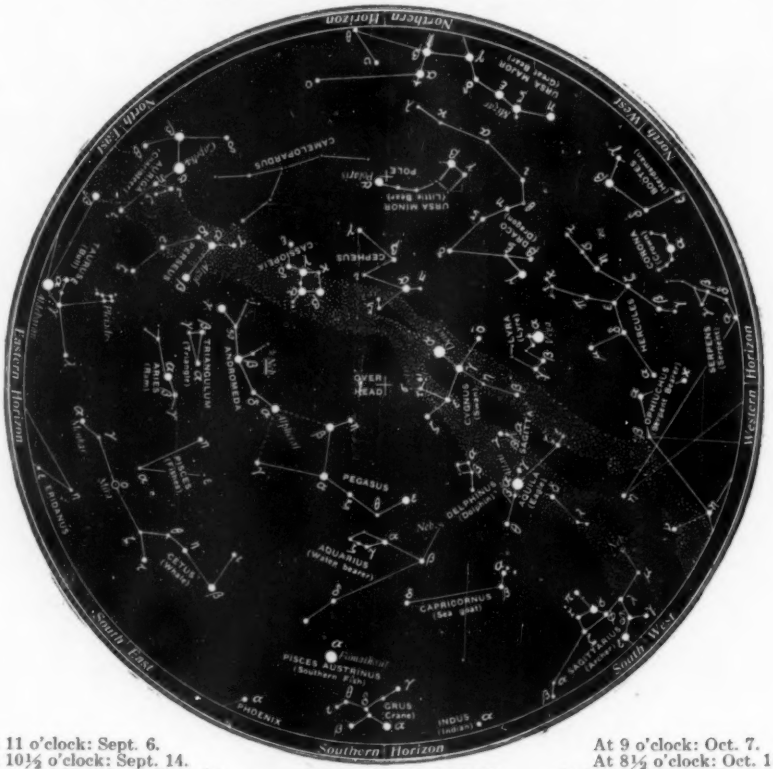
The Back Yard Astronomer

(*Continued from page* 270)

attempted to sleep instead of staying awake all night to settle points in telescope making. A single mosquito, doubtless the incarnation of some evil spirit, prevented said sleep from taking place. This amateur, no sooner had day broken, secured a shovel and by herculean efforts dug a ditch that drained the pond which doubtless represented the old homestead of the mosquito. So, next year when you come to the get-together, you will find the bottom of the pond dusty and the last mosquito vanished from Vermont. Now will you come?—*A. G. I., Tel. Ed.*

The Heavens in September

BY PROF. HENRY NORRIS RUSSELL, Ph. D.



At 11 o'clock: Sept. 6. At 9 o'clock: Oct. 7.
At 10½ o'clock: Sept. 14. At 8½ o'clock: Oct. 15.
At 10 o'clock: Sept. 21. At 9½ o'clock: Sept. 30. At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time in in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

MERCURY is now an evening star. During the latter part of the month he is well clear of the Sun, reaching the greatest elongation, 26 degrees, on the 30th. However, since he is 12 degrees farther south than the Sun, he is at a disadvantage for northern observers, setting not long after 6:30 P.M., so that he can be seen only in the twilight.

Venus is an evening star too, and is in conjunction with Mercury on the 10th and again on the 30th. On the former date the two are too near the Sun to be seen easily, but on the latter Venus should be conspicuous and should help to find Mercury which is three and one half degrees to the southward. Between these dates Mercury is near Venus and may be picked up to the left of the brighter planet and a little below her.

Mars is in quadrature with the Sun on the 14th and is then due south at 5:48 A.M. He is in Gemini at about 10:30 P.M. and his increase in brightness as he draws nearer the Earth is conspicuous. Although he is still about a hundred million miles away, astronomers will be hard at work measuring the planet's heat, photographing the surface, and observing it visually.

Jupiter is in Aries, rising between 8 and 9 P.M., through the whole of the year.

Saturn is in quadrature east of the Sun on the 5th and can be seen till late in the evening.

Uranus is in opposition on the 28th—in R. A. $0^h\ 20^m$; declination $+1°\ 28'$, when he may be found with the aid of a good star map. He is just visible to the naked eye, but a field glass will be a great help in finding him, even if it is one of very poor power.

Neptune is a morning star just past conjunction and hardly observable.

The Moon is in her last quarter at 5:35 P.M. on the 6th; new at 8:21 P.M. on the 13th; in her first quarter at 9:58 P.M. on the 21st; and full at 7:43 A.M. on the 29th. She is nearest the Earth on the 4th, and farthest away on the 20th. Upon her round of the zodiac she overtakes Uranus on the 2nd, Jupiter on the 4th, Mars on the 7th, Neptune on the 12th, Venus and Mercury on the 15th, Saturn on the 20th, and Uranus again on the 29th.

At 2 A.M. on the 23rd the Sun crosses the celestial equator and passes through the point of the heavens which is called the autumnal equinox; at which moment, according to the almanacs, "autumn commences."

Industries From Atoms

(*Continued from page* 264)

authorities in this important branch of rubber manufacture, pointed out at a recent meeting of the American Chemical Society that the day has just arrived when the research chemists have joined forces in a campaign to attempt really to *regenerate* vulcanized rubber.

"Present-day processes," says Mr. Shoaff, "never re-impart the two properties of solidity and elasticity exhibited by raw rubber. Vulcanized rubber, especially after long use has undergone such complex physico-chemical changes that we may never restore it to its original state, though it is certainly not beyond the realm of possibilities in this day of seeming miracles.

"Just as vulcanizing is more than the result of the combination of rubber and sulfur, so the removal of the combined sulfur may not be expected to re-impart automatically the properties of the original rubber. When Spence removed a large portion of the combined sulfur from vulcanized rubber with aniline-sodium he obtained a plastic material; probably due to the softening effect of the aniline. Dubose did not obtain a plastic product when he effected the removal of over 50 percent of the combined sulfur from vulcanized rubber by boiling it in a solution of hexamethylenetetramine. It seems that in the devulcanizing process we have to deal more with depolymerization or disaggregation; and if the removal of combined sulfur should coincidentally restore vulcanized rubber to something like its original condition, we must look farther than a method such as the alkali process or any of the proposed schemes described in the hundreds of patents on the subject.

"Solvent processes cause depolymerization to a high degree, as is shown by the changes in v scosity. The solvent dissolves the depolymerized materials and the product tends to be too soft and tacky for ordinary use. Some modification of Bary's osmotic process in which he employed xyiene may be the answer. Catalysis will no doubt play a principal role in true regeneration. The problem merits the attention of the research chemist in co-ordination with his efforts to learn the mechanism of vulcanization, if for no other reason than that the solution of either may lead to the discovery of the other."

Thus an industry built upon the still mysterious phenomenon of vulcanization seeks the secret of reversing that process, a secret upon which may be built, eventually, new industries of comparable magnitude.

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GRAMMARIANS tell us that adjectives of color can not be compared. In other words, a thing may be "black" but can not be "blacker." Any one who has ever cleaned out a kerosene stove will agree that as far as carbon black goes, nothing *could* be blacker. The carbon black produced for commercial purposes is made by burning natural gas under conditions which cause the deposit of the maximum amount of the "soot." One of the main uses for the product is in the rubber industry, where it is an important compounding ingredient.

An idea of the magnitude of the carbon black industry in this country is revealed by statistics just issued for the state of

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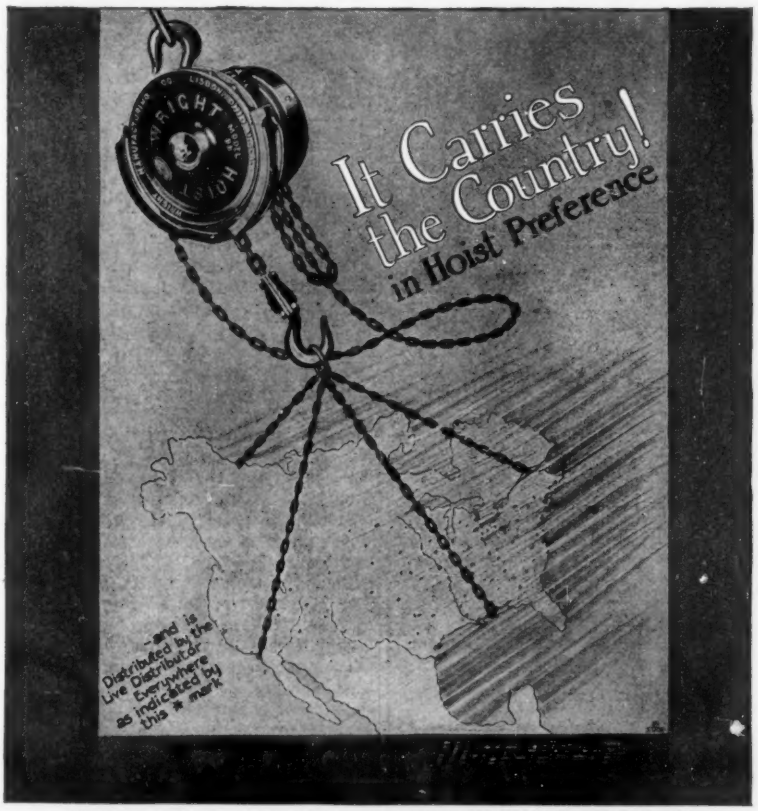

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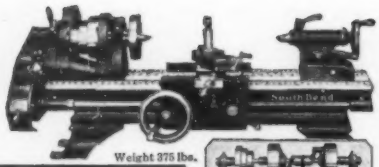

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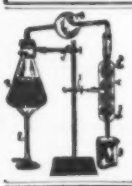

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Texas. Although the law allows only the residue from natural gas after it has passed through casinghead gasoline plants to be burned for making carbon black, the production of the latter in Texas this year is expected to exceed 75,000,000 pounds. In 1927 the output of carbon black in Texas was 20,174,409 pounds. It is stated that before the end of the year more than a dozen plants will be in operation, most of them in the Panhandle district.

Steel Photographs Produced With Aid of High Explosive

SHOOTING a photograph into the hardest of chrome steel with the aid of high explosive nitro-starch, and so making a photographic record as permanent as the steel itself, is the feat that has been accomplished as a result of the "Munroe effect." This effect was the discovery of Dr. Charles E. Munroe, veteran explosives expert of the United States Bureau of Mines here.

Dr. Charles E. Munroe examining a photograph of himself reproduced in steel by the Munroe effect

A steel photograph was made recently by G. St. J. Perrott, superintendent of the Bureau of Mines experiment station at Pittsburgh, and sent by him to Dr. Munroe. To make it, a zinc etching, such as is used in reproducing illustrations in printed matter, was made from the photograph, and then this was used to make a paper mold. A mold of flour could also be used. The mold was then placed on a piece of steel about two inches in diameter and an inch thick. On top of this was placed a disc shaped piece of the nitro-starch explosive, which was then fired. Though the mold was destroyed, when the steel cooled sufficiently to be handled, the profile of Dr. Munroe was found impressed on its surface. Where the photograph had been black, that is, in the shadows, the surface of the steel was raised, and where there had been high lights, the steel was incised.

Another example of the effect that is in Dr. Munroe's possession now was made by W. O. Snelling, director of research of the Trojan Powder Company. In this case the words "Munroe Effect" were impressed into the surface of a block of the explosive, so that the letters were in intaglio. When this was exploded on a disc of the steel the

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letters appeared on it. However, they were also in intaglio on the steel. This is the opposite from what would be obtained with a die, for then the intaglio letters on the die would come out in relief on the finished product.

Dr. Munroe explains the effect by saying that when the detonation of the explosive occurs, the entire amount of the solid is converted to gas. This volume of gas, however, momentarily has the same size and shape as the original block of the explosive, and is therefore extremely compressed. Where there was a cavity in the original explosive is the line of least resistance for the escape of the rapidly moving gas molecules. In seeking to escape, they collide with each other, producing a vast number of tiny molecular drills, which bore into the hardest steel.

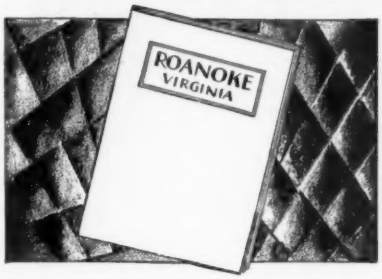
The photograph which was pressed in steel by the Munroe effect

Using the same principle, Dr. Munroe once blew a hole in a safe with a hollow cylinder of dynamite. He took a bundle of sticks of dynamite, then, by pushing a tin can through the center, he pushed out the center sticks, and bound together the other ones so as to form a ring. This he exploded in a vertical position upon a safe. The result was a hole in the top of the safe corresponding to the hollow center in the ring of dynamite sticks. This hollow cylinder had acted as a gun to fire the gas molecules through the steel.

Another example of the Munroe effect. The words are stamped in

Any thin object, such as a leaf, can be reproduced on steel in this way, said Dr. Munroe, and so a permanent record can be obtained.—*Science Service.*

A city of Amazing GROWTH



Invites You to write for this Survey

WHAT better indicator of a city's industrial facilities than its growth? Here are the figures on Roanoke: In 1880, its population was 669; in four years it grew to 5,000. Six more years raised it to 16,000. Today, its community population is past the 80,000 mark!

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This is a book for the inventor; it tells him what to do and what not to do after his invention is perfected, if he hopes to make money from his idea. Chapters on finding a buyer, on royalties, on the field for inventions, on forms of contract, on placing a value on the patent, on pitfalls for patentees, are especially valuable. Every patent attorney should read it and pass it on to the inventors who are his clients. Appearing first only a year ago, it now is in its third printing.

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24 West 40th Street, New York, N. Y.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Hooks and Eyes

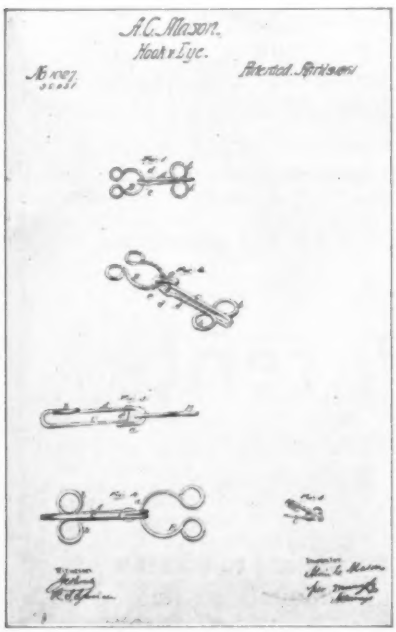
WHO invented the hook and eye fastener?

Ask any number of men that question, and out of every ten who will answer, nine will say De Long. They will be mistaken. Who really was the original hook and eye inventor is hard to say, but the earliest patentee of whom we happen to have knowledge is Alvin Childs Mason, of Springfield, Vermont.

Mason's patent issued April 9, 1861. He describes it by saying:

"The object of the within described invention is to facilitate the unhooking or detaching of the hooks from the eyes when necessary, and also to prevent the bending and injuring of the snap or spring-guard, a contingency consequent on the difficulty and embarrassment frequently attending the unhooking of the hooks provided with the usual snap or spring-guard.

"The within described invention consists in having the end of the snap or spring-guard bent so as to extend obliquely into



The World War saw the rise of the hookless fastener; the Civil War saw the rise of the hook and eye

a loop or opening in the hook, substantially as hereinafter shown and described, whereby the desired end is attained."

But what of Frank E. DeLong? He was a late comer in the field, his patent issuing October 1, 1889. He describes his invention as follows:

"My invention consists of a hook or fastening for a garment, composed of front and rear portions or the hook proper and the shank formed of substantially parallel sides or bars, and a tongue having its free end forming a loop coincident with the bend of the hook, said hook and loop being intermediate of said side bars."

While the De Long hook and eye was a useful invention, it was a slogan that made it really famous. In a day when advertising and slogans were not so widespread as they are now, the whole world associated De Long and hooks and eyes with the famous catch-phrase "See that hump!"

The Crowded Art of Slot Machines

"I HAVE an idea for a new invention," someone writes to this department nearly every week. "It is to sell tooth brushes [or sandwiches or some other universally used article] through slot machines. I am willing to sell my right to obtain a patent for a substantial sum."

We have yet to receive such a letter suggesting something we have not already seen sold by vending machines. Following are only a few things you can obtain by dropping a coin in a slot:

Newspapers and magazines
Matches
Peanuts
Chewing gum
Pop corn
Postcards
Target practice
Stereopticon views
Your weight
Postage stamps
Towels
Perfume
Napkins
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Saving bank receipts
Pencils
Candy
Drinking cups
Sandwiches
Aprons
Milk
Tooth brushes and tooth paste
Music
Ice cream cones
Combs
Soap
Stationery
Handkerchiefs
Bloomers

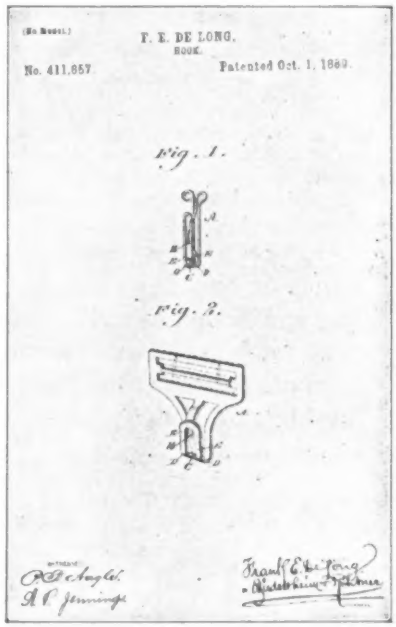
Such a partial list is suggestive of the fact that it is difficult to think of a new machine-vended article. And even if you could think of one, that is not invention. The invention must lie in the novelty of the machine you devise for the purpose. Here there is difficulty, for we have had vending machines for many years and the degree of patentable novelty remaining in the art does not seem to be great. Nevertheless, every once in a while an inventor does come out with a new idea in slot machines which rewards him handsomely.

Delayed Claims

IF you have a right to use a patented invention, do not delay to assert that right. Your delay may have the effect of stopping you from asserting it at a later date.

Such proved to be the case with regard to the recent controversy between The Texas Company and the Gulf Refining Company, over the patent obtained in 1922 by Almer M. McAfee for a process for converting, by the use of aluminum chloride, high boiling petroleum oils into low boiling products, including gasoline.

Soon after McAfee obtained his Doctor of Philosophy degree at Columbia University, he became employed in the laboratory of The Texas Company, his superior being G. W. Gray, a chemist. Pursuant to Gray's orders, McAfee developed his



This is the patent, used with the slogan, "See that hump," which made the hook and eye famous

process for making gasoline. Gray, however, applied for a patent in his own name; the company paying the cost of the application. McAfee protested at his name not being included in the application, but the company refused to recognize his claim to either that invention or another one he had made.

McAfee resigned and entered the employ of the Gulf Refining Company. He applied for a patent and his new employer bore the expense. The Patent Office declared an interference with Gray's patent. After a four-year contest, McAfee finally was declared the rightful inventor and the patent issued to the Gulf Company, his assignee.

All this time The Texas Company was claiming that Gray was the inventor. Not until October, 1924, when it filed a suit in a Texas State Court, did it claim a shop right in the process on the ground that it was invented by McAfee while in the employ of the company. It was too late.

Judge Walker, spokesman for the Circuit Court of Appeals for the Fifth Circuit, writes as follows:

"Long before the litigation as to the patent began the appellant was aware that McAfee claimed to be the inventor of the patented process. From the beginning appellant had knowledge of the facts upon which it based the claim asserted in this suit. Notwithstanding its possession of that knowledge, for more than nine years it refrained from making the claim now asserted, in the meantime so conducting itself as to conceal from appellee even the probability or possibility of such a claim being made, though from the time appellant was first informed that McAfee claimed to be the inventor or discoverer of the process in question it was open to appellant to assert its equitable ownership of that invention or discovery and to compel the transfer to itself of the right thereto before the patent was issued.

"The circumstances of appellant's delay in disclosing the existence of the right now asserted were such that that delay had the effect of a concealment calculated to influence appellee to change its position in a way that was to its detriment if the decision it was seeking to bring about could result in no material benefit to appellee.

"For reasons above indicated, we are of opinion that appellant's delay, in the circumstances disclosed, in making such claim as the one it seeks to enforce in this suit, had the effect of stopping it to assert and enforce that claim against appellee."

For Humane Inventors

THE difficulty of finding just the right invention for a particular purpose is indicated by the following advertisement which appeared recently in the *Illustrated London News:*

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For further particulars apply to the Chief Secretary of The Royal Society for the Prevention of Cruelty to Animals, 105 Jermyn Street, London S.W.1, England.

Taxes and Royalties

DID you know that you need pay no state income tax upon patent royalties? The United States Supreme Court, considering the petition of Henry F. Long, Commissioner of Corporations and Taxation of the Commonwealth of Massachusetts, against George J. Rockwood, has held recently that a state tax upon royalties received for use of patents issued by the Federal Government is prohibited by the Constitution. Such a tax, it holds, would amount to a tax upon the patent right itself.

"The power to exclude others, granted by the United States to the patentee, subserves a definite purpose—to promote the progress of science and useful arts," says Judge McReynolds. "The patent is the instrument by which that end is to be accomplished. It affords protection during the specified period in consideration of benefits conferred by inventor. And the settled doctrine is that such instrumentalities may not be taxed by the states.

"As United States patents grant only the right to exclude, our conclusion is not in conflict with those cases which sustain the power of the states to exercise control over articles manufactured by patentees, to regulate the assignment of patent rights, and to prevent fraud in connection therewith."

In a dissenting opinion Justice Holmes says:

"Obviously it is not true that patents are instrumentalities of the Government. They are used by the patentees for their private advantage alone. If the Government uses them it must pay like other people.

"The fact that the franchise came from a grant by the United States is no more reason for exempting, standing by itself, than is the derivation of a title to a lot of land from the same source."

Double Registry in China

CIVIL war in China naturally has had its effect on American firms doing business there. One government rules a large portion of the country from the ancient capital at Pekin, while another directs a large and commercially important section with Nankin as its capital. This schism has resulted in the issuance of the following order:

"Notice is hereby given that all firms who have registered their trademarks in the Ministry of Agriculture, Trade and Commerce in Pekin and (or) with local authorities, must re-register such trademarks with the Nationalist Government on or before March 24, 1928, failing which, registration with the Pekin Government will be declared null and void, and future protection by law will not be guaranteed."

Since March 28 it has been necessary to register trademarks originally at both capitals in order to secure protection covering the whole of China.

The American Firm Wins

AT last an American manufacturer has succeeded in getting a court decision giving back to him trademark rights which had been appropriated by another in a foreign country. The trademark in question is "Fashion Park," registered by Rosenberg Brothers of Rochester.

In 1918, their Havana agent, Enrique Edelstein, registered the trademark in Cuba in his own name. Six years ago he

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT—With an auxiliary propeller which may be tilted at an angle to control the ascent or descent of the plane, also to aid in direct flight, or as an emergency power. Patent 1671865. K. Karish, 1559 E. 7th St., Brooklyn, N. Y.

SLACK BALLOON WITH ELASTIC DEFORMATION—Capable of automatically changing the volume of the balloon in dependence of the variations of internal or external pressure, without causing appreciable variations in shape. Patent 1671922. L. Avorio, c/o L. Laboccetta, via Due Macelli 31, Rome, Italy.

Pertaining to Apparel

HAT—Which will actually be a hat of chic appearance for street wear, or an emergency waterproof covering for a turban, or small hat of the cloche type. Patent 1671890. R. E. Chaine, 415 Madison Ave., New York, N. Y.

CEREMONIAL VEIL—A bridal or confirmation veil constructed ready for wear, in order that anyone may don the same properly draped over the head, and properly ornamented. Patent 1671889. G. L. Dorros, c/o Dorros Bros., 1 East 33rd St., New York, N. Y.

LACE—With a special arrangement of draw string receiving loops, certain of the loops being omitted, to give the desired arc or curvature when drawn. Patent 1673629. J. Loopo, c/o Domestic Lace House, Inc., 2 E. 23rd St., New York, N. Y.

Chemical Processes

PROCESS FOR EXTRACTING METALS FROM METALLIC SULPHIDES—By means of which sulphide ores, concentrates, and other metallic sulphide-bearing materials can be treated and the metals extracted therefrom in a practical manner. Patent 1671003. A. B. Bagsar, Box 3006, Huntington, W. Va.

PROCESS FOR EXTRACTING METALLIC NICKEL—Very suitable for recovering nickel from nickel-bearing solutions which are produced in copper refineries in the course of the electrolytic refining of copper. Patent 1671004. A. B. Bagsar, Box 3006, Huntington, W. Va.

Designs

DESIGN FOR A JEWELRY SETTING—Patent 75370. F. C. Joseph, 1316 Morris Ave., New York, N. Y.

DESIGN FOR A CAKE PAN OR THE LIKE—Patent 75427. S. Joseph, 23 East 22nd St., New York, N. Y.

Electrical Devices

ELECTRICAL TERMINAL—Which can be applied to the end of a stranded conductor and the bared ends securely wrapped and firmly held when applied to a binding post. Patent 1671905. E. D. McKenna, 81 Chambers St., New York, N. Y.

COMPOSITION—An electron emission element comprising a metallic core of comparatively high conductivity, and a coating on the core, the coating consisting of an oxysulphureted substance. Patent 1671007. H. L. Berger, 115 Palisade Ave., Jersey City, N. J.

ELECTRIC CUT-OUT FOR STILLS AND THE LIKE—Which includes means for breaking the circuit when the body of liquid in which the device is submerged is diminished to extent to uncover the fusible element. Patent 1672800. L. F. Boss, c/o Marine Biological Laboratory, Woods Hole, Mass.

lost the agency. Nevertheless, he has been able to prevent the sale of Fashion Park clothing in Cuba.

After a prolonged legal fight the American manufacturers have succeeded in obtaining an executive order ratifying the decision of the Bureau of Patents and Trademarks which canceled Edelstein's registration. This action is in accordance with the precepts of the Chile Convention for the Protection of Trademarks, of which both the United States and Cuba are signatories. Rosenberg Brothers may now sell their product in Cuba under their own trademark.

Britain Rewards Inventors

IN Great Britain a patentee who wishes to claim payment from the Crown for the use of his invention may either pursue his rights under the Patent Act or apply for an *ex gratia* award. In the former case he files his claim and establishes that his patent is valid and has been infringed. Should he fail to prove his case he has no redress.

On the other hand, he may abandon his patent rights and apply for the *ex gratia* award. The Crown admits neither validity nor infringement, but, if the inventor proves that he made the invention, that the Crown used it, and that there is a causal connection between the making and the using by the Crown, then he may be given an award in accordance with the equities in the case.

Such awards as the government has made in the last two years are listed in a report to Parliament from the Royal Commission on Awards to Inventors. Sixty-seven claims have been dealt with and a number of substantial awards made. Among them are the following:

Peter Brotherhood, Limited, 25,000 pounds for improvements in internal combustion engines.

The Electric Boat Company and others, 12,880 pounds for improvements in submarines.

Messrs. Vickers, Limited, 7500 pounds for wind-balanced ring mountings.

A. E. A. Dagory, 3500 pounds for a method of decoppering guns.

Metropolitan Vickers Electrical Company, Limited, 4000 pounds plus royalties, for wireless reception apparatus.

A. I. Caquot, 3000 pounds for the Caquot balloon.

Norman A. Thompson, 3000 pounds for improvements in flying boats.

The New London Ship and Engine Company, 2000 pounds for Diesel Engines for submarines.

C. Chilawsky and P. Langrin, 2000 pounds for improvements in signaling.

Women Inventors Increase

INVENTIONS by women are increasing more rapidly than those made by men, according to a report made by the Children's Bureau of the Department of Labor, after an investigation of patent office records covering a period of ten years. The second five years have shown an increase of 35 percent in the women's output over the first five years, as against a less than 17 percent increase on the part of the men inventors.

Of the more than 5000 patents issued to women in the ten-year period, the greatest number in any one class, 1385 were for household inventions, and the next greatest, 1090, were for articles of personal wear and use. The list also includes, however, 221 patents in agriculture, forestry, and animal husbandry, 223 in manufacturing, 208 in structural materials, 345 in transportation, 378 for supplies for use in industry, agriculture, commerce, and the home, 227 in medical, surgical, and dental equipment, 211 in amusement, 129 in safety and sanitation, and the remainder scattered through such fields as mining and smelting equipment, steam laundries and firearms. There are even nine inventions by women for fishing tackle.

As inventors women still lag behind the men, with only 2 percent of the total number of inventions to their credit in the ten-year period. Their productivity, however, is increasing twice as fast as that of the men, and it is possible that at some distant date the two sexes may be displaying equal ingenuity.

Invention Without Knowledge

CAN an inventor obtain a patent upon an invention which he does not fully understand?

Such was the question presented recently for solution in the infringement action brought between the United States Industrial Chemical Company against the Theroz Company in the Circuit Court of Appeals for the Fourth Circuit. The Theroz Company as assignee was operating under three patents, two issued to Jacob Schaub and one to Henry M. Brigham. The patents cover an artificial fuel, popularly known as solid alcohol. It is said to have supplanted the "canned heat" manufactured and sold by the Sterno Corporation during the years 1914 to 1920 and until the Sterno Corporation began to infringe the patents of the Theroz Company.

When the Theroz Company sued the United States Industrial Chemical Company and the Sterno Corporation for infringement, the Federal District Court of Maryland held the two Schaub patents valid and infringed and held the Brigham patent void on the ground that it was anticipated by the Schaub patents. When the case came up on appeal, the attorneys for the Industrial Chemical Company contended, among other things, that Schaub's patents were not valid because of his ignorance with respect to the fact that it is the acetone in commercial ethyl alcohol which is the solvent of nitrocellulose and that it is the water contained in commercial ethyl alcohol which is a coagulant.

"We are not impressed with the argument," Judge Parker held. "Schaub was experimenting with alcohol of the commercial grades; and if through such experiments he discovered a way to attain the result which he was seeking, and correctly described it in his application for a patent, it makes no difference whether or not he understood the chemical theory or the natural laws underlying the process. A partial enumeration of the great inventions and discoveries which have involved the use of forces and elements not understood by the inventors themselves would unduly lengthen this opinion. And if it be true that Schaub stumbled upon an important invention without understanding the reasons for what he had accomplished, it will not have been the first time that truth has been withheld from the wise and learned and revealed to the humble seeker."

After disposing of a number of other contentions, the decision upheld the decree of the District Court.

CRYSTAL DETECTOR—Having universal movement with respect to its co-acting electrode so that a very large range of selectivity can be had, and means for holding the electrode against movement. Patent 1670589. F. J. Martin, 4050 Maple Ave., Oakland, Cal.

PULL-CHAIN TERMINAL—For electric lights, made from light material such as thin sheet brass, but so constructed that it is strong enough to risist a tension strain. Patent 1672929. J. J. Cook, 1230 So. Wabash Ave., Chicago, Ill.

VARIABLE CONDENSER—For radios, whereby the possibility of current losses is reduced to a minimum, the manufacturing cost lowered, and the assembly rendered extremely simple. Patent 1673213. T. W. Sukumlyn, 1543½ East Washington St., Los Angeles, Calif.

Of Interest to Farmers

BROODER—In which ample fresh air will be supplied at all times, and the heating means beneath the brooder cannot result in injury to the chicks. Patent 1671039. I. Mead, R. F. D. No. 1, Rockford, Ill.

HONEYCOMB FOUNDATION—Of the type known as "extracting" frames, constructed of a tough composition of hard fiber, in place of wax usually employed in the practice. Patent 1672853. H. L. Settle, Payette, Idaho.

EGG TRAY—Having a movable egg-supporting bottom and stationary individual egg holders, for properly turning and positioning the eggs in an incubator, at all times. Patent 1672774. C. T. Patterson and H. W. Young, c/o Moisture Guide Co., Springfield, Missouri.

Of General Interest

BUILDING BLOCK—Formed of cementitious material, embedded and in surrounding relation with a metallic reinforcing frame incorporated in the walls of the block, and substantially the same shape. Patent 1671893. V. E. Easterday, Sr., Box 646, Urbana, Ill.

METHOD OF PERMANENTLY STRAIGHTENING KINKY HAIR—Which leaves it straight without the use of any grease, acid or listerine, so that the owner may have a clean head and permanently straight hair. Patent 1671857. J. W. Embrey, c/o Dr. R. Caldwell, 831 New Donaghey Bldg., Little Rock, Ark.

IRONING BOARD—Adapted to be attached to a closet door, will occupy very little space and may be readily extended in operative position at any desired angle. Patent 1671881. C. E. Barrie, 6 Water St. Extension, Plymouth, Mass.

HAIR WAVER—Characterized by convenience of assembly, operation and control, as well as being constructed not to strain or injure the hair being "marcel" waved. Patent 1672775. W. J. Perkins and E. Hagemeister, c/o Mrs. Emma Hagemeister, 58 Chancery St., Astoria, L. I., N. Y.

COLLAPSIBLE BOX—Of the type used for the shipment of suits and cloaks, having additional strength and rigidity to prevent collapsing condition when in use. Patent 1671029. M. Feinberg, c/o Ritt & Goldman, 191 Joralemon St., Brooklyn, N. Y.

ATTACHMENT FOR HOUSEHOLD REFRIGERATORS—Which may be connected and supported within an open door of a refrigerator, for collecting chips of ice which have been removed from the block. Patent 1670959. S. G. Garrett, 604 Atlas Life Bldg., Tulsa, Okla.

NURSING-BOTTLE HOLDER—Which may be conveniently attached to a baby carriage or other suitable support and adjusted to dispose the bottle at the proper angle. Patent 1671085. T. Nuernberg, 214 Hope Ave., Passaic, N. J.

GRILLE—Constructed to permit the occupant of an apartment to observe applicants for entrance without opening the door to an intruder. Patent 1670948. G. W. Ackerman, c/o Ackerman Door Interviewer Co., 211 W. 231 St., New York, N. Y.

TOOTHBRUSH—Having a ball or spherical-shaped brush which fits any conformation of teeth and will effectually clean inner and outer faces of the teeth. Patent 1671891. J. A. Dolan, 55 Spooner St., Floral Park, L. I., N. Y.

PORTABLE BARBER'S CHAIR—Especially designed for use in hotels or clubhouses, capable of being readily moved to the room of a customer, yet immovable when occupied. Patent 1671556. S. Sterling, Los Angeles Biltmore, Los Angeles, Calif.

SURFACE CLEANER—So constructed as to present surfaces and edges which will conform to the contour of cooking utensils, or similar household articles, to be cleaned. Patent 1672818. L. F. M. Lea, Billop Ave., Tottenville, S. I., N. Y.

SOAP HOLDER FOR BRUSHES—Which permits the application of soap to the surface being cleaned, yet allows the normal use of the brush in scrubbing the surface. Patent 1671348. V. F. Creegan, c/o Postal Telegraph Co., Albuquerque, N. M.

CLEANING DEVICE—In the form of a brush, having a concave depression at the rear for holding a roll of cleaning fabric, for removing spots or otherwise cleaning garments. Patent 1672772. —H. A. Mund, 150-37, 121st Ave., Baisley Park, Jamaica, L. I., N. Y.

Hardware and Tools

STAPLE—Whose prongs are reinforced to facilitate the piercing of the material, and which obviates the bending of the prongs in the fastening operation. Patent 1671895. J. Fritz, c/o Fritz Tabor Mfg. Co., 17 N. Water St., New Bedford, Mass.

FASTENING DEVICE—A supporting member especially adapted for use in holding a fire place front cover in place, may be adjusted for holding the fastening taut. Patent 1670995. J. H. Sutton, La Grange, N. C.

VISE—Comprising but relatively few parts, with facilities for gripping and firmly holding a piston, or like article, without causing injury to the outer surface. Patent 1672808. J. J. Hansel, Fremont, Mich.

STEAM-BOILER-CLEANING TOOL—A fork, one tine of which is provided with a roller, the other with a cutting point, adapted for scraping parts or walls of a boiler. Patent 1672757. S. Gabrielse, c/o Nederlandsch Octrooi-Butran, 31 Laan Copes Van Cattenburch S. Gravenhage, Holland.

Heating and Lighting

DAMPER REGULATOR—Designed for automatically controlling the dampers of boiler flues of low pressure systems, whereby the dampers are gradually opened or closed, instead of instantly. Patent 1671892. C. H. Dutcher, c/o Messrs. Kielly & Mueller, 34 W. 13th St., New York, N. Y.

AUTOMATIC DAMPER — A normally open damper, with an adjustable counter balance, adapted to be closed by the draft through a flue whenever the draft exceeds a predetermined minimum. Patent 1672758. A. Given, 201 N. Elm St., Toppenish, Wash.

ADJUSTABLE BRACKET FOR LAMPS—Which is artistic in appearance, may be adjustably positioned on a standard, and conveniently removed for replacement, is inexpensive to manufacture. Patent 1672794. A. J. Tizley, c/o E. F. Caldwell Co., 36 W. 15th St., New York, N. Y.

Machines and Mechanical Devices

METHOD OF AND DEVICE FOR CEMENTING WELLS—Especially designed for use where a plurality of oil producing sands are to be protected against cavings, or the down flow of water, by means of cementation. Patent 1673616. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

ICE-FREEZING TANK—In which a greater tonnage of ice is produced with a smaller total footage of coils, the relatively short coils being easily removable for repair. Patent 1671945. H. P. Fell, c/o Dry Milk Co., 15 Park Row, New York, N. Y.

SECTIONAL PACKING GLAND AND WASHER—Which may be assembled on a shaft or other mechanical element without taking down the shaft or removing objects mounted thereon, particularly adapted for windmills. Patent 1671909. J. F. Struble, 225 East "B" St., Hutchinson, Kansas.

CONNECTING ROD—Wherein the usual lining is eleminated at both ends, and the parts surrounding the crank shaft are adjustable to take care of wear without bushings. Patent 1671859. —H. N. Gundelach, 157 W. 103rd St., New York, N. Y.

OPTICAL LENS GRINDING AND SURFACING MACHINE—For grinding and surfacing both spherical and cylindrical lenses, the motions being automatic after proper settings are once made. Patent 1671027. H. A. George, c/o Steele & Tipton, Attys., Superior, Wis.

DISHWASHING MACHINE—Which will automatically wash, rinse and steam dishes, and will automatically at predetermined intervals introduce a fresh fluid into the machine. Patent 1670611. E. L. Couch, c/o Couch & Dean, 250 Park Ave., New York, N. Y.

SCRAPER FOR WRINGERS—A structure wherein the wringer may be used intermittently or continually, and which will prevent the clothes passing through the wringer from adhering to the rollers. Patent 1672824. H. L. Morin, 6011 John R St., Detroit, Mich.

FIDDLE SNATCH BLOCK—Intended for the leads of both the main falls and topping lift on a hoisting derrick, taking the place of the two blocks commonly employed. Patent 1672823. T. A. McMillan, c/o W. H. McMillan & Sons, 49 South St., New York, N. Y.

EXTRACTOR FOR LAUNDRIES—Which provides means, involving the minimum amount of labor and time, for squeezing the water from clothes, without twisting or entangling the same. Patent 1671913. M. Troy, c/o Cascade Steam Laundry, 835 Myrtle Ave., Brooklyn, N. Y.

Medical Devices

APPLICATOR—By means of which a pre-determined amount of medicine may be deposited within the vagina adjacent the uterus, without any backflow. Patent 1670605. E. S. Aeilts, Little Rock, Iowa.

URINAL—Which will be a convenience to invalid male adults, or infants, adapted to be applied to a person, and may be connected with another container. Patent 1672748. C. J. Bruner, 288 North 4th St., Columbus, Ohio.

NOSE AND MOUTH SHIELD FOR DIAGNOSTIC REFLECTORS—Capable of being adjustably associated with a head reflector, such as are worn by opticians or physicians, in illuminating the eyes, or throat. Patent 1671342. J. J. Cantor, 512½ Lucas Ave., Los Angeles, Calif.

Musical Devices

MUSICAL INSTRUMENT—Having a vibratile member and means whereby the pitch of the member may be changed, permitting the playing of tunes from a special sheet of music. Patent 1671882. W. Bartholomae, 7913 Bay Parkway, Brooklyn, N. Y.

Prime Movers and Their Accessories

FUEL MIXER—An interceptor, adapted to insure a complete separation of all unvaporized or liquid fuel from the column of air and vapor about to enter the combustion chamber. Patent 1671897. S. S. Gentile, 400 Louisville Ave., Monroe, La.

POWER PLANT—Which eliminates all reciprocating parts, is not subjected to bearing friction, produces a constant torque, provides effective scavenging and utilizes any known motive agent. Patent 1670953. M. I. Browne, Delia, Kans.

SPARK PLUG—Having means for automatically holding the sparking terminal, irrespective of the rotation movement of the points of contact, and means for cooling the terminal. Patent 1672956. C. A. Schreiber, R. No. 1, Cedar Lake, Ind.

Railways and Their Accessories

TIE AND FASTENER—So constructed that a single set of parts may be differently adjusted to provide insulation or non-insulation, reinforcement or non-reinforcement, yet permitting a firm clamping action. Patent 1670994. J. G. and A. N. Snyder, c/o Keystone Metal Tie Co., 441 Lexington Ave., New York, N. Y.

VALVE FOR AIR-BRAKE SYSTEMS—An angle valve which will provide for a safer handling of trains, either during movement or when necessary to disconnect for making repairs. Patent 1670950. J. Bell and W. H. Sagstetler, 441 Ewing Ave., Decatur, Ill.

Pertaining to Recreation

AMUSEMENT APPARATUS — A receptacle adapted to hold liquid, and to be penetrated by small missile, the flowing liquid releasing balls, by the action of gravity, to a scoring board. Patent 1671000. H. S. Weinstein, 480 Jefferson Ave., Brooklyn, N. Y.

TEETER—Or See-Saw, which is so made that it may be used either to rotate, or see-saw, or converted into a slide. Patent 1672754. W. B. Delisle, 313 Benton Ave., Springfield, Missouri.

Pertaining to Vehicles

ATTACHMENT FOR STEERING RODS—Which will not only maintain the parts associated with the rod from rattling, but will prevent the rod from slipping from its connections. Patent 1670954. W. E. Coleman, 211 Lake St., Shreveport, La.

AUTOMOBILE BODY CONSTRUCTION—Designed for touring purposes, and so constructed that sleeping quarters may be provided by the lowering of hinged platforms constituting portions of the sides of the body. Patent 1671457. G. P. Wiedman, c/o Weidman Body Co., No. Tonawanda, N. Y.

SIGNAL—For pneumatic tires, an audible, automatic signal, controlled by a spring in opposition to air pressure in the inner tube for giving warning of the loss of air. Patent 1671852. W. A. Caldwell, Box 576, Manila, Philippine Islands.

HEADLIGHT—Providing the maximum efficiency, at the same time eliminating glare, the device being inexpensive to manufacture, the reflector forming part of the framework. Patent 1671900. W. Irwin, 342 Madison Ave., Flushing, L. I., N. Y.

AUTOMOBILE SIGNAL DEVICE—Which may be operated by vacuum action created by the engine to project a signal into view from a car, such as a sedan. Patent 1671200. M. C. Merrill, Flaxton, N. D.

RECOIL MECHANISM—Designed to eliminate the sudden checking of the upward rebounding movement of a vehicle body, and allowing a normal elevation without jerking movement. Patent 1671410. C. M. Cronkhite, 1345 Graynold Ave., Glendale, Calif.

MOTOR-VEHICLE BUMPER — Rigidly constructed side bumper with rubber shock absorbers, especially built for hard collisions, and particularly adaptable on taxis and buses. Patent 1665536. W. A. Dierker, 359 Dean St., Brooklyn, N. Y.

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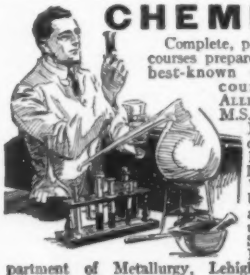

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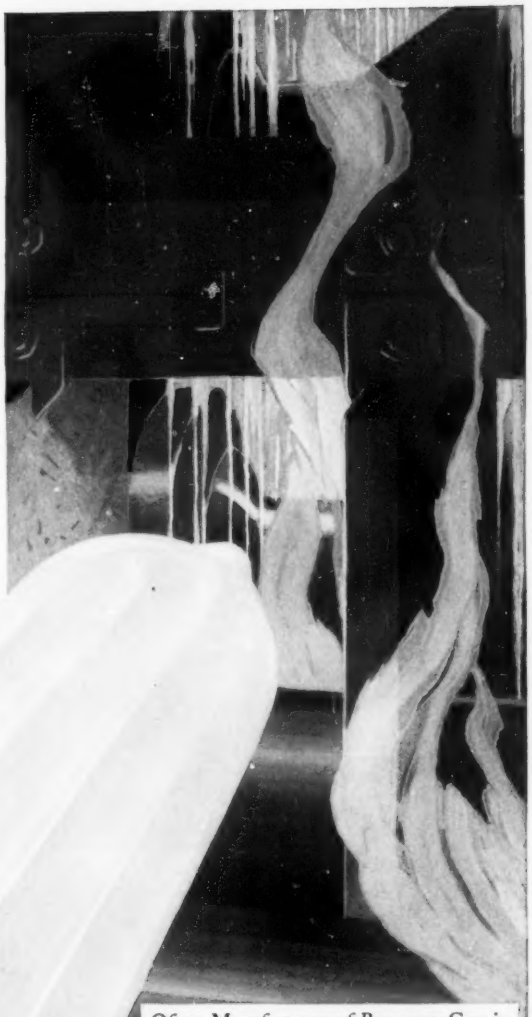

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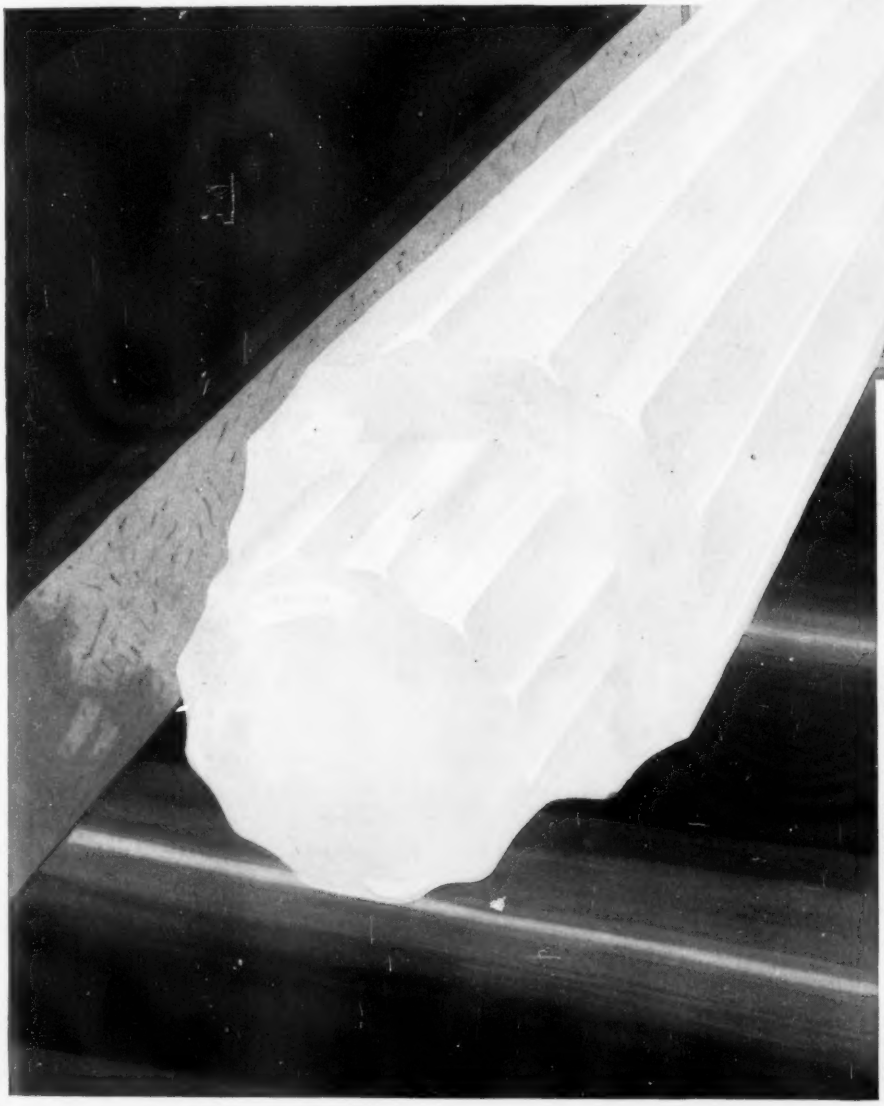

Of 40 Manufacturers of Passenger Cars in This Country, 35 Use Timken Bearings at the Points Indicated by Crosses

Make	Model	Front Wheels	Rear Wheels	Pinion	Steering	Differential
Auburn	All	x	x	x		x
Cadillac	All	x	x		x	x
Chandler	Special 6	x	x	x		x
	Big 6 & Royal 8	x		x		x
Chrysler	52-62-72	x	x	x		x
	80	x				x
Cunningham	All	x	x	x		x
Dodge	All	x	x			x
Durant	4-M 2 and 55	x	x	x		
	65 & 75	x	x	x		x
Elcar	6-70	x				x
	8-78, 8-82	x	x			x
	8-91, 8-92	x	x			x
Falcon	All	x	x	x	x	x
Ford	All	x		x	x	x
Franklin	All	x	x	x	x	x
Gardner	All	x	x	x		x
Graham-Paige	610	x	x	x		x
	614	x	x			x
	619, 629, 835	x	x		x	x
Hudson and Essex	All	x	x	x		x
Hupmobile	6	x	x	x		x
	Big 8	x	x			x
	Century 8	x	x	x	x	x
Jordan	All	x	x	x	x	x
Kissel	All	x	x	x		x
Kleiber		x	x	x		x
LaSalle	All					x
Lincoln	All	x	x	x	x	x
Locomobile	8-70	x	x			x
Marmon	68	x				x
	78		x			
McFarlan	All	x	x	x		x
Moon	All	x	x	x		x
Nash	Std 6	x	x	x		x
	6 and 8	x				x
Peerless	8-69	x	x			x
	6-91, 6-60 and 6-80	x	x	x		x
Pierce-Arrow	81	x	x	x		x
	36	x	x			
Reo	Flying Cloud	x	x		x	x
	Wolverine	x	x		x	x
Roamer		x				
Stearns-Knight	All	x	x	x	x	x
Studebaker and Erskine	All	x	x	x	x	x
Stutz	All	x	x	x		x
Velie	All	x	x	x	x	x
Willys-Overland	Whippet 4	x	x	x	x	x
	Whippet 6	x	x	x	x	x
	56	x	x	x	x	x
	66-A	x			x	x
	70-A	x		x	x	x

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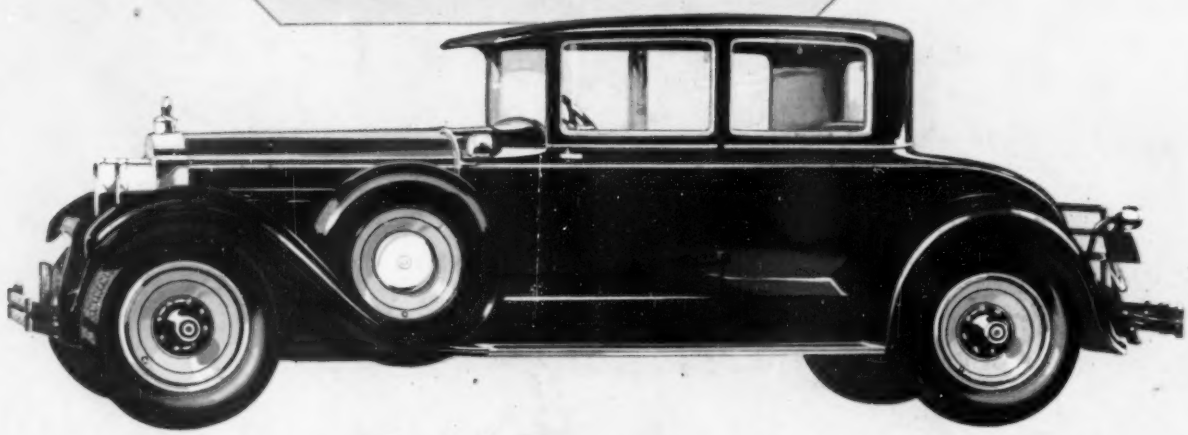

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